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GAS

CORROSION PREVENTION
AND
PLASTIC PIPE ISSUE

ENGINEERING • UTILIZATION • PIPELINES • MANAGEMENT

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Modern Rockwell No. 4 aluminum meters *slip with ease* into any manifold previously arranged to accommodate Rockwell No. 4 iron body meters. The dimensions are the same. But what a difference in weight . . . only 176 lbs as against 530 lbs. Actually, this meter weighs little more than a tin meter of like capacity. And with it you get the safety of single joint construction—the impact and corrosion resistance of a strong aluminum alloy meter case.

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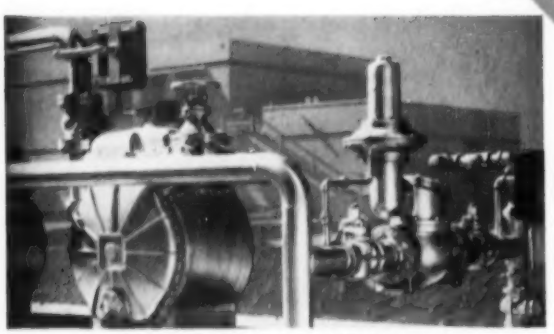
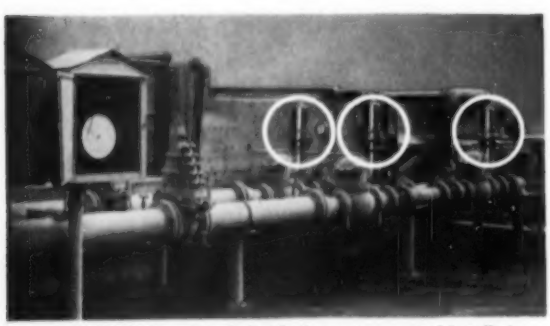


RELIANCE industrial control installation



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RELIANCE REGULATOR DIVISION
ALHAMBRA, CALIFORNIA

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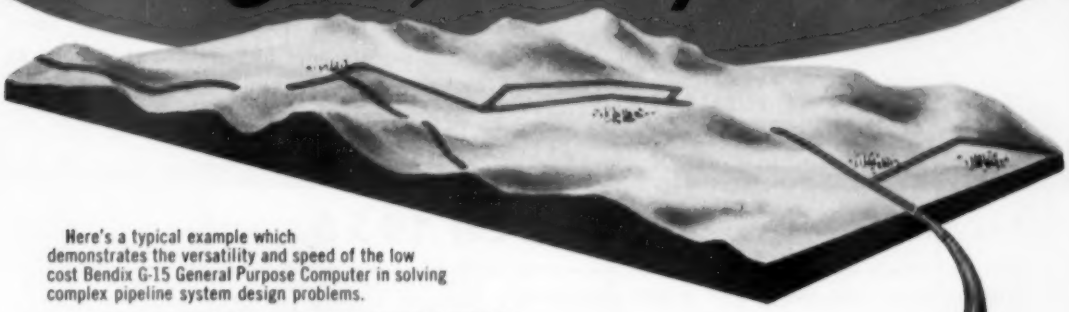
Bendix Computer



Here's a typical example which demonstrates the versatility and speed of the low cost Bendix G-15 General Purpose Computer in solving complex pipeline system design problems.

A proposed system of pipelines 160 miles long with 1800 feet variation in altitude, was to consist of a number of pipes of different diameters running in parallel over eleven given sections. At the end of the sections, gas was to enter the flow from another source or be branched off to another destination. In addition, two compressors were to be placed at various sections along the line.

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GAS

32nd YEAR OF PUBLICATION

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BPA

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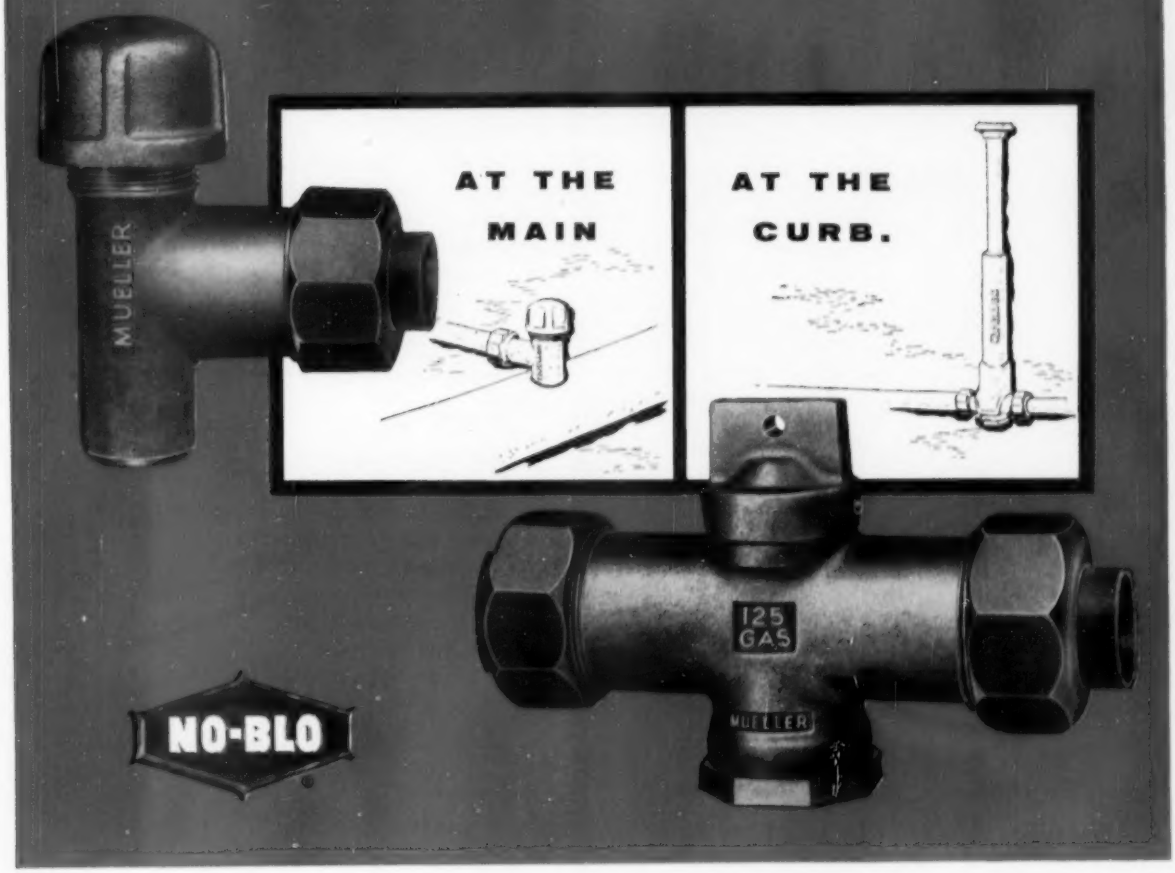
NBP

Control Corrosion



You can control corrosion at the main or at the curb with Mueller® Tees or Curb Stops with insulating coupling. This coupling completely insulates the service pipe from the tee or stop, breaking the galvanic circuit.

Corrosion can be controlled at the main with Mueller Service Tees, Service Valve Tees or Curb Valve Tees that incorporate the insulating coupling outlet to fit steel or Type "K" copper pipe.

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Replace damaged curb stops or make new curb stop installations without shutting off the service at the main. Use a Mueller Line Stopper Fitting to stop-off the service line, cut out a short section of pipe and slip the Mueller Cutting-In Curb Stop in place.

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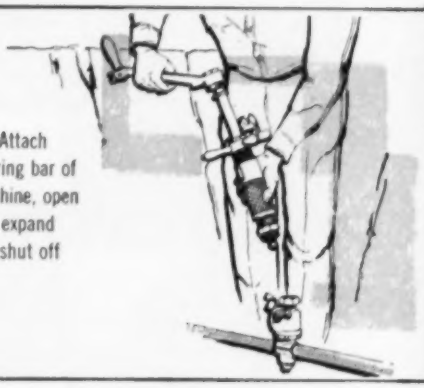
STEP 1

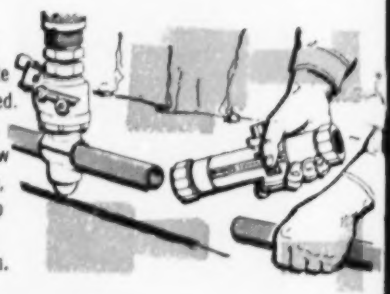
Drill line! Weld line stopper fitting at least 6" from point where stop is to be inserted. Attach control chamber or gate valve and make cut with E-4, T, D-4, or DH-2 Mueller Drilling Machine.

STEP 2



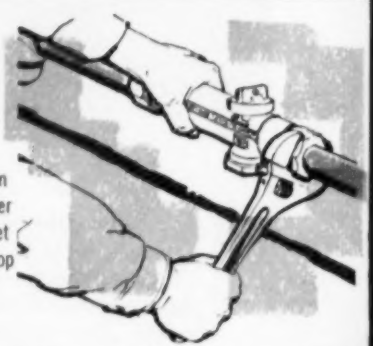
Make stop-off! Attach rubber stopper to boring bar of machine, mount machine, open valve, and lower and expand stopper. Gas is now shut off in service line.

STEP 3



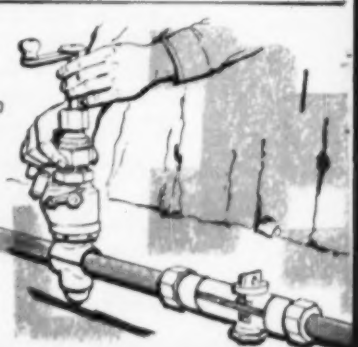
Insert stop! Marks on Cutting-In Curb Stop indicate length of pipe to be removed. (Include existing curb stop, if any.) Slip long end of new stop onto upstream section, then slide other end of stop as far as possible over re-aligned downstream section.

STEP 4



Tighten stop! Downstream section of pipe is now resting against shoulder on inside of stop—this prevents movement when stop is closed. Tighten Dresser nuts firmly. (If threaded inlet stop is used, threads hold stop in position.)

STEP 5



Plug fitting! Close curb stop release and withdraw stopper and close valve. Mount completion machine with completion plug on valve or control chamber. Open valve, insert plug, remove completion machine and valve.

STEP 6

Complete installation! Tighten completion plug, attach [illegible] and install Mueller Curb Box over new Curb Stop. Entire installation has been made under pressure, without loss of gas and in complete safety.

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GAS Thermally Thinking

Integrated public relations program needed

NOW is the time for all segments of the industry to join hands and give serious thought to a fully integrated public information program—an industry-wide effort with breadth and depth that has never heretofore been undertaken. Although the industry has long realized the need for such a program, the recently completed Senate battle over regulation of natural gas producers has clearly outlined, for the first time, the scope and purposes of the program.

During the debate over the Harris-Fulbright legislation, together with the extensive public arguments in the press and elsewhere on the bill, the producers did an outstanding job of informing the public of their part in the over-all industry picture. They made a good point of their costs of operation and effectively told the story to the gas consuming public.

The retail distributors of gas, however, left something to be desired in presenting their side of the picture. Although in a better position to reach the gas consumer because of their close association with him, the distribution companies failed to make a point of their costs of operation. In addition, they did not take full advantage of the argument that because of public regulation their margin of profit is confined within close limits.

The country's gas distributors have an interesting and worthwhile story to tell of their operating problems and the costs involved; of the extensive investment they have made to serve their consumers and the general public of the area; of the manner in which they are controlled by public regulation; and the many phases of their operations which would serve to make the public aware of the distributors side of the picture.

The fact that the Senate bill was vetoed by President Eisenhower, resulting in a victory for the distributors, does not eliminate the need this group has for a public information program. After all, in vetoing the bill the President pointed out that he thought the bill was basically in the public interest, and that his veto was based on certain questionable practices on the part of lobbying groups.

Now that it is all over, at least for the time being, there is no question but that a greater segment of the public is aware of the basis for the householders' gas bills than ever before. Whether or not consumers have a true picture is subject to debate.

As the dust lays on the recent battle, the industry will have time for a considered appraisal of its course for the future. And, in plotting a course for the future, each segment—producer, transmitter and distributor—should look to a public information program that would further the interests of the gas industry as a whole, rather than its own interests at the expense of one of the other operating arms of the industry. This means an all-out program of public education which is designed to tell the story of natural gas—its value to the consumer and the whole reasoning behind the consumers monthly gas bill.

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highlights

GAS SPOT NEWS, TRENDS, COMMENT ON GAS INDUSTRY AFFAIRS

Independent producers lose fight for freedom to Presidential veto

It appears that Congress will take no further action this year to remove direct Federal regulation of independent natural gas producers. The President's veto really killed it—supporters see no chance of getting the two-thirds majority needed to pass the Harris bill over the veto as the House approved it by only six votes and the margin in the Senate was 53 to 38. Senate Majority Leader Johnson (D.-Texas) said veto means ". . . less and less gas at higher and higher prices." On the other hand, Council of Local Gas Companies recommended veto and lauds the President's action.

Chicago area may get new natural gas supply from west

Natural Gas Pipeline Co. of America—one leg of the dual gas supply to the People Gas Light & Coke Co., distributor in the Chicago area—has plans for a 36- and 30-incher from Beatrice, Neb., to Joliet, Ill., to deliver an additional 435 MMcf/d to Peoples Gas and other utility customers. Colorado Interstate will supply the gas and bring 350 MMcf/d of it to Beatrice in a new pipeline extending from their system in eastern Colorado. Project will mean three distinct natural gas supplies for Peoples Gas and surrounding Midwest utilities—200,000 space heating customers waiting there for the FPC to approve the plans. Estimated cost—$80 million.

Canadian gas involved with new supply to Chicago

Colorado Interstate will supply 435 MMcf/d to Peoples Gas and other Midwest distribution companies if FPC approves. Their prime supply produced in Guymon—Hugoton and Panhandle fields—reserves huge. Colorado is building pipeline to tap Pacific Northwest's Scenic Inch, which will handle production from San Juan Basin and Peace River (Canada) gas fields. Colorado gets 100 MMcf/d from the Scenic Inch and, through the $68 million line planned to connect with the proposed Natural Gas Pipeline Co.'s line, conceivably Peoples Gas could be delivered Canadian and/or San Juan gas.

From a field editor's notes

President indicated Harris bill was needed in the public interest — he said ". . . present law (FPC control) will discourage individual initiative and incentive to explore for and develop new sources of supply. In the long run this will limit supplies of gas, which is contrary not only to the national interest, but especially to the interest of the consumers . . . " Then, he vetoed it because of reputed actions by a ". . . small segment of a great and vital industry . . ." Does this mean that such tactics by any small group can stall legislation on any matter in the public interest? Shouldn't legislation be considered on merits alone? . . . Transcontinental Gas Pipe Line Corp. has put its new gas engine-driven compressor station on the line — they believe this is a first. . . . Biggest battle in FPC history on over TGT & Midwestern application — nearly 100 intervenors showed up for Feb. 14 opening hearings. . . . Hear, and see, that the electric industry has launched the largest sales campaign in its history. . . . New Fallon Bill (H. R. 8836) provides for $24.8 billion, 40,000-mile highway system — has provisions for reimbursing utilities having to relocate facilities — utilities seem ready to go along with it as a start.

Appliance man says gas will top oil for househeating in '56

GAMA's managing director, Harold Massey, predicted last month that before the end of the year gas will have replaced oil as the nation's No. 1 homeheating fuel. He also sees "the definite possibility that gas furnace sales alone will pass the one-million-unit mark." Other predictions: water heater sales could pass the three-million mark for the first time, incinerator manufacturers are looking for a 40% increase in sales volume, range makers can up sales as much as 20% over 1955.

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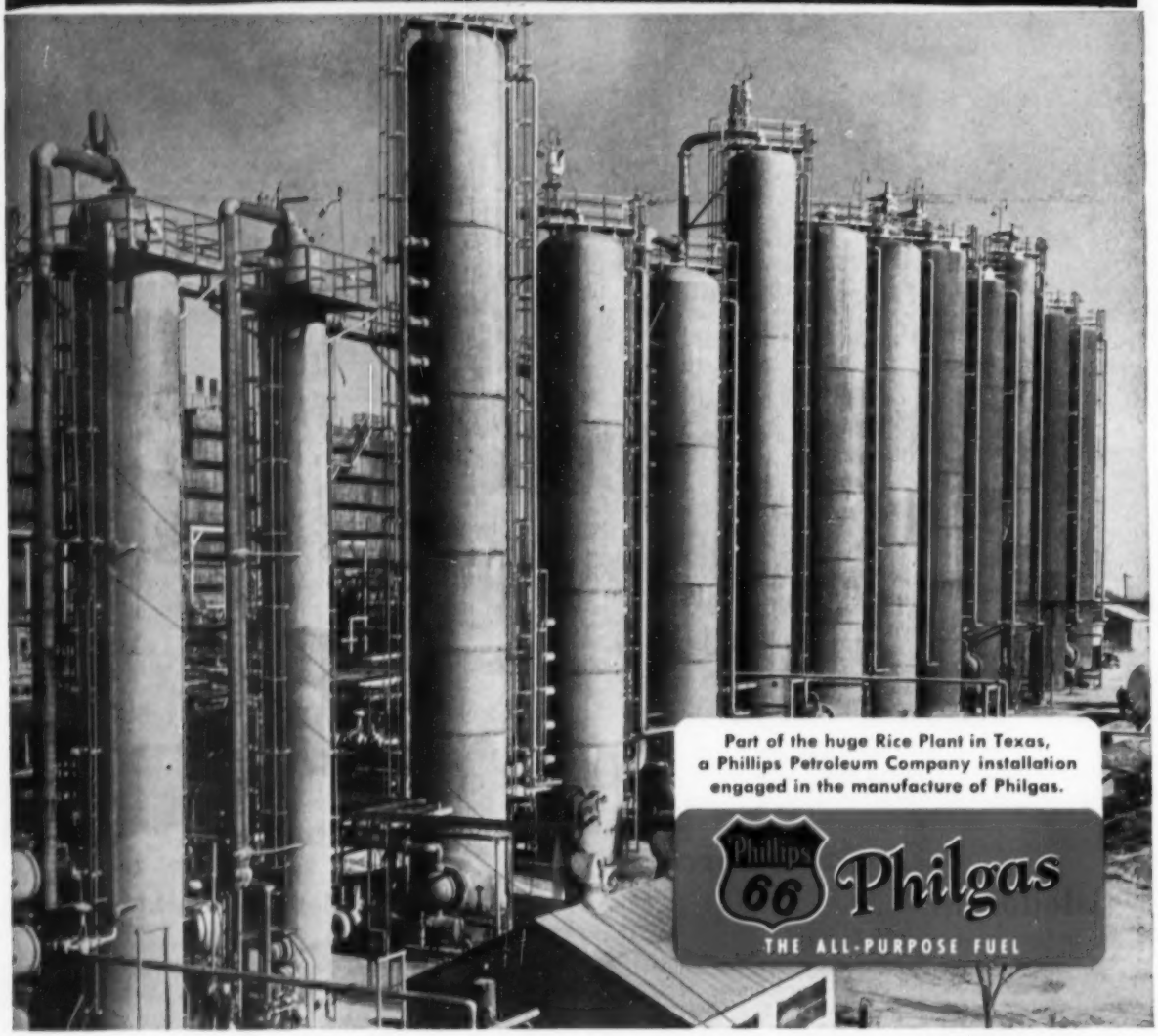
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*regulatory and legislative trends

CANADIAN GAS GOES TO MARKET

WITH the recent denial by the FPC of a rehearing in the latest case involving Pacific Northwest Pipeline Corp., the way has been cleared for the first importation of large volumes of Canadian natural gas into the United States.

When one realizes that the United States gas supply has shrunk in the last 10 years from an indicated remaining life of 32 years to 21 years, then the supplemental supply from Canada becomes important to millions of consumers, investors and employees in the $16 billion gas industry.

The importation of gas from the Peace river region in Canada to the Pacific Northwest states appears to be only the beginning. In January of this year, FPC released this news:

"The Federal Power Commission has scheduled consolidated hearings to commence Feb. 14 in Washington, D. C., on applications by Midwestern Gas Transmission Co. and Tennessee Gas Transmission Co., both of Houston, Texas, involving the proposed import and export of natural gas from and to Canada.

"Midwestern is proposing to build a $97,988,000 pipeline project extending from a connection with Tennessee's system near Portland, Tenn., to a point on the U.S.-Canadian border where it would receive 204 million cubic feet of natural gas per day from Trans-Canada Pipe Lines Ltd. near Emerson, Manitoba. Midwestern also would purchase another 204 million cu ft per day from Tennessee at the Portland connection. The gas would be sold to utility companies and municipalities in Illinois-Wisconsin-Minnesota area.

"Tennessee is also proposing to sell up to 86,755,000 cu ft of gas daily to Trans-Canada near Niagara Falls, N.Y., for export to the Montreal, Canada, area. Tennessee's proposed export would extend for three years after initial delivery, or until Trans-Canada is ready to commence deliveries in eastern Canada through its proposed all-Canadian line. Tennessee also is seeking authority, in two other applications, to construct additional pipeline facilities to provide the additional capacity for the delivery of the gas to Midwestern and for deliveries of additional gas to existing customers.

"In a concurrent order the Commission denied a motion by Northern Natural Gas Co., of Omaha, Neb., to dismiss the Tennessee and Midwestern applications."

Canadian gas contract is unique

The recent FPC proceeding authorizing the importation of 303 MMcf/d of Canadian natural gas reveals the unique character of the contract between Westcoast Transmission Company Ltd. and Pacific Northwest Pipeline Corp. The importation of gas is scheduled to start on Nov. 1, 1957. The Canadian supply contract is for a period of 20 years with the price for gas delivered on a 90% load factor basis at the international border to be $0.2225/Mcf until 1959 and $0.2200/Mcf for the remainder of the term. In the United States, private sales contracts made by a regulated natural gas company are subordinate to the power of FPC to change the price when the cost of rendering the gas service at wholesale changes with economic conditions. Canada does not have a regulatory agency equivalent to FPC, and the Canadian gas sales contract requiring the Canadian supplier to deliver gas for a fixed price for two decades is unique. No company purchasing natural gas from an interstate supplier can rely on the duration of the price specified in the contract, but here is a natural gas supply contract containing a permanent price for Canadian gas.

Public convenience and necessity

In appraising the public convenience and necessity of this international integrated pipeline project, the FPC stated that:

"Pacific Northwest's proposed gas supply is dependent upon the importation of up to 303,462 Mcf of natural gas per day from Canada. An export

*A monthly commentary on national and state developments by an expert in the field of utility law.

Canadian gas ... Since Oct. 1, there have been 22 new gas discoveries in the Peace River area

permit has been granted to Westcoast for the export of this volume of natural gas, which is firm for a twenty-year period and which takes precedence over any subsequently developed demands within Canada. Determination of the adequacy of Pacific Northwest's supply of natural gas necessitates a consideration of the proposed project of Westcoast including its gas supply and facilities.

"As a supplementary source of gas for a market primarily served with natural gas coming from the opposite end of an integrated system, the present proposal of Pacific Northwest has many advantages. For the first few years at least, the additional volumes of gas will be largely used for interruptible industrial purposes, which will be curtailed when necessary to provide increased demands for firm service to domestic and commercial customers. Furthermore, the existence of a source of gas supply at both ends of the system will enable emergency service in the event of a line break or other accident which might interrupt the receipt of gas from certain of Pacific Northwest's other sources of gas."

"The total estimated Westcoast sales for the third year peak day are 370,116 Mcf which is the present design sales capacity of the Westcoast project. By the addition of compressors the Westcoast project can be expanded to a capacity of 660,000 Mcf per day." • • •

"The evidence shows that Westcoast can meet Pacific Northwest's maximum day requirements from Canada or 303,462 Mcf from January 1, 1957 through 1976, as well as the other requirements of Westcoast's system in Canada. The total volume required by Pacific Northwest for the partial year of 1957 and the subsequent twenty-year period of operation through 1977 is 2,364,740,000 Mcf, of which 2,338,610,000 Mcf is presently available and committed.

"The recoverable reserve estimates are as of October 1, 1954. Since that time there have been twenty-two new gas discoveries in the Peace River area. Some of these new discoveries extend fields committed to the Westcoast project. We therefore conclude that the estimates of recoverable gas available to Westcoast, and thus to Pacific Northwest, are reasonably adequate to support the proposed project."

Concerning the $142 million Canadian pipeline project, FPC asserted that the latest route is better than the first one proposed, which involved great risk of interrupted gas service. Describing the 650 mi of 30-in. OD main pipeline from Taylor, B. C. to the U. S.-Canadian border, FPC declared that:

"The route of Westcoast's line differs materially in only one respect from that proposed in connection with the earlier application of its United States affiliate, which was heard with Pacific Northwest's G-1429 application, and rejected by our Opinion No. 271 and accompanying order. This one material change of route is the substitution of the Boston Bar Pass for the Coquihalla Pass, the accessibility of the latter for winter maintenance having been questioned. Although higher and with lower winter temperatures, the Boston Bar Pass has terrain features and accessibility which makes the selected route possible.

"The record shows that the proposed facilities of Westcoast are adequate to render the service proposed, and we so find.

"The feasibility of Westcoast's project has also been shown. Its estimates of cost were prepared by engineers experienced in the construction of the Trans-Mountain oil pipe line in the same area. Considering local conditions and present costs, it was estimated that the total over-all cost of Westcoast's project would be $142,000,000. The estimate appears reasonable."

Westcoast plans to finance the construction of its facilities by selling securities and obtaining bank loans. The net proceeds were estimated to be $105 million from 4.25% bonds; $21.6 million from 6% debentures; $14.4 million from common stock; and $1 million from a bank loan at 3.75% interest.

Regarding the economic feasibility of the Canadian project, FPC recited the evidence showing that the estimated rate of return would increase from 5.44% in 1958 to 6.19% in 1960. Then FPC concluded by saying:

"Upon consideration of all the evidence, it is reasonable to conclude that Westcoast's project can be successfully consummated and that its project is otherwise feasible and we so find.

"Westcoast has obtained from local and Dominion authorities all authorizations necessary for its proposed exportation of gas from Canada. The terms and provisions of the various authorizations adequately permit the sales and service proposed to be rendered by Westcoast."

International goodwill

The integrated Canadian - Pacific Northwest project makes it feasible for Vancouver, B. C., to receive natural gas service for the first time. It also makes available a large-volume, economical, supplementary natural gas supply for the consumers in the Pacific Northwest states. The Pacific Coast states are experiencing the largest in-migration of people in the history of mankind, so connecting the Canadian source of supply is important to the future public interest on the Pacific Coast. Also, 50 MMcf/d of Canadian gas will become available, in effect, to El Paso Natural Gas in the San Juan basin from Pacific Northwest Pipeline Corp. by substitution. El Paso delivers San Juan basin gas to New Mexico, Arizona, Nevada, and California. The FPC found this new arrangement to be in the public interest. It said:

"It is immaterial whether the gas is actually delivered to El Paso at the Canadian border and immediately returned to Pacific Northwest at that point, as indicated by the exchange agreement or whether the Border purchase by El Paso is accepted as a reality with the exchange being recognized for what it is without the implementation of physical delivery and redelivery as contemplated.

"We emphasize, however, that this conclusion is based upon the peculiar facts in this case and is not to be taken as a deviation from our established policies respecting interchange of gas with designations of specific sources of gas for a particular customer and related problems which are common in many types of exchange and involve other problems not present here."

Surely these mutual benefits from this integrated U. S.-Canadian pipeline enterprise will increase internation goodwill. ■

Holan 4154 Gas Construction Body. Notice pipe trough on left side rear door with bottom section that drops down to become a step.

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blueprints and catalog information on all gas bodies you see on this page.

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Air compressor bodies with left handed compartments and air winch for backfilling.

Air compressor bodies with pipe compartment and provisions for oxygen and acetylene tanks.

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Although it romped by the Senate, the bill to free producers from federal control was lobbied to death. Here's how the measure cleared the Senate.

WASHINGTON

President's veto snags Harris bill

Direct from Hubert Kelley Jr. and George M. Riveire Jr.

NATURAL gas producers heaved a premature sigh of relief on passage of the Harris-Fulbright bill (it wound up as the Harris bill), but the presidential veto quickly doused these notes. What was thought to have been a big legislative victory for producers has been turned into a major public relations defeat for the gas industry as a whole.

The three-week Senate debate on the bill was accompanied by lobbying pressures from proponents and opponents of the measure that mounted to an intensity that caused anger among many of the lawmakers. Topping it off was the celebrated incident involving an alleged attempt to buy the vote of Sen. Francis Case (R., S.D.). Apart from the merits of the charge, the national attention focused on the incident did not do the gas industry any good in terms of public esteem.

The bill was "over-lobbied," complained Sen. George Aiken (R., Vt.). Sen. Albert Gore (D., Tenn.) protested against extreme pressure from both factions. Sen. Irving Ives (R., N.Y.) said he was overwhelmed by mountainous volumes of postcards and letters on the issue. All three voted against the bill.

Every type of lobbying tactic was employed by both sides, according to many senators, including the technique of getting to the solons through old friends. Senator Aiken asserted that the pro-bill forces had explored the background of every senator to get a line on anyone who might exert some persuasion on his vote.

The electrifying statement of Senator Case that John M. Neff, an attorney from Lexington, Neb., had left a $2500 campaign contribution (the senator is up for re-election this year) with a South Dakota friend of Case's, possibly to influence his gas vote, set off immediate repercussions. A special Senate committee launched a quick probe of the incident and another announced plans for a broader examination of the lobbying activities of the gas and oil industry.

In addition, the Federal Bureau of Investigation and the Securities and Exchange Commission looked into the matter. And at the White House, President Eisenhower warned that campaign contributions bear close watching.

Senator Case said that he was favorably disposed toward the Harris-Fulbright bill before he learned of the contribution. But, he added, knowledge of the action forced him to vote against the measure in order to preserve the freedom of senators and "keep their vision unblurred by the color of currency left in an envelope."

What all this poor publicity for the industry could mean in the future is uncertain. However, it is likely that the lobbying furor will make the public more sensitive to any gas price increases that might follow the signing of the bill. And should producers return to Congress later seeking an end to all regulation the bad after-taste left by the Senate battle could make their position extremely difficult.

Despite the to-do over the alleged bribe attempt the gas measure passed by a surprisingly comfortable 53 to 38 vote (the predicted margin was half a dozen ballots). There was an attempt by the bill's antagonists to hold up the vote pending investigation of the Case episode, and it took the Senate three hours of heated wrangling to decide to vote first and probe later.

Leading the act-now forces who won the day was Senate Majority Leader Lyndon Johnson (D., Texas). He argued that the Senate would "render itself impotent to conduct its business in an orderly fashion if transactions with persons outside the Senate" caused the chamber to postpone votes. He added that the remits of the influence charge should not be determined by the results of the gas bill tally.

Sen. Paul Douglas (D., Ill.), bitterest opponent of the bill, countered by quoting from "Alice in Wonderland." "I remember," he said wrily, "when the Red Queen was conducting the trial and Alice suggested that they should have evidence. The Red Queen replied, 'No, judgment first and evidence afterward.'"

Senator Douglas' protests were futile and many hours later, at 8:30 p.m., the final vote was in and the Federal Power Commission's regulatory functions were curtailed.

Sectionally, the Harris-Fulbright bill, as expected, garnered its main support from the Southwest and West, including the principal source states for interstate gas—Kansas, Louisiana, Mississippi, New Mexico, and Texas.

But there was no clear-cut pattern otherwise. Certainly, the bill wasn't a partisan measure. Democrats split almost down the middle, 22 being for passage and 24 against. Republicans divided 31 for and 14 against.

Major opposition to the bill came not from the interstate gas-consuming Midwest but from middle, and in some cases coal-producing, states as Kentucky, Tennessee, Virginia, West Virginia, and Missouri. Senators from these states, which are also interstate gas buyers, voted solidly against the measure.

Harris bill... Opponents' amendments and back-to-committee motions repulsed

Declaring his unalterable opposition to the bill, Sen. Alben Barkley (D., Ky.) said:

"I care not whether gas and oil are mostly produced by 35 companies which produce 70% of the entire production, or whether the companies engaged in gas and oil production are widely distributed. Gas and oil companies are public utilities and are monopolies, because gas and oil are a part of the resources of our country . . ."

The Midwest was anything but a united front on the gas issue. Only Michigan and Minnesota formed a solid block against passage, while Iowa voted solidly for enactment. Split were the senators from Indiana, Illinois, Ohio, and Wisconsin.

Voting a jumble

The New England voting was also a jumble. Both New Hampshire senators lined up for the bill, while Rhode Island and Connecticut represented solid opposition. In Massachusetts, Maine and Vermont the vote was split.

While most deep Dixie legislators went along with the bill, the senators from Alabama and Georgia, both fairly large interstate gas importers, opposed the measure. Moving north, we find that South Carolina cast ballots solidly for the bill, and North Carolina split.

In justifying their votes for the bill, the South Carolinians cited the cause of "states rights," saying the issue was, in part, a matter of state versus federal regulation.

"I firmly believe," Sen. Olin Johnston said, "that I am casting a vote for states rights, for less government in business, and at the same time assuring gas companies in my state and the other states of adequate federal protection against exorbitant gas rates . . ."

His colleague, Sen. Strom Thurmond, also declared his preference for state regulation, when it's a choice between that and federal intervention.

"If the federal government can regulate the price a man can get for the gas produced on his land," he contended, "it is just as logical to argue that the government can control the price for which he can sell cotton, corn, wheat, milk, Kaolin clay, titanium and other resources from the soil."

One of the most interesting voting splits was that of Pennsylvania, a big coal state that is also one of the largest interstate gas customers. Republican Senator Edward Martin voted for the gas bill, and his GOP colleague, James Duff, against.

Senator Martin said he was interested in maintaining an adequate supply of gas at the lowest consumer price, and that lifting direct FPC price regulation would serve both goals. Senator Duff, on the other hand, discounted fears that wellhead regulation would discourage gas companies from drilling because "most gas is discovered in connection with the exploration for oil."

He conceded that it is "exceedingly difficult" to fairly regulate the price of gas but complained that the gas bill does not contain an adequate yardstick whereby FPC can establish a "reasonable market price" to safeguard consumers.

Recommittal motion

Before the final vote proponents of the Harris-Fulbright bill had to repulse a motion to send it back to committee, plus several amendments. The recommittal motion was defeated 64-30 and the opposition amendments were beaten in every case by at least 13 votes. The three principal amendments were (1) to require FPC to consider "the protection of the interest of the consumer" in determining "reasonable market price"; (2) to substitute the language "fair and equitable" for the bill's wording of "reasonable market price"; and (3) to substitute the Harris-Fulbright bill with one exempting from direct FPC regulation only small gas producers.

The last move made by the bill's adherents before the final vote was the offering of minor amendments to bring the language of the Fulbright bill into perfect conformity with the House-passed Harris bill. This, in effect, would completely substitute the Harris measure for the Fulbright bill.

The strategy behind this was to prevent, at all cost, the bill from having to go back to the House for approval after Senate passage. The bill's supporters knew the Harris bill had squeezed by the House last year by a breath-taking narrow 029-203 margin and that reconsideration by the lower chamber might easily result in a reversed decision.

Senator Douglas tried to block substitution of the bills through parliamentary maneuvers. But the evening was getting along, the lawmakers were tired after a long day, and the switch was adopted by voice vote. Some moments later the final tally case. ■

GAS current reading

TABLES OF THERMAL PROPERTIES OF GASES—by Joseph Hilsenrath, C. W. Beckett, W. S. Benedict, Lila Fano, H. J. Hoge, J. F. Masi, R. L. Nuttall, Y. S. Touloukian, and H. W. Woolley. (National Bureau of Standards Circular 564, 478 pages, $3.75. Order from the Government Printing Office, Washington 25, D. C.)

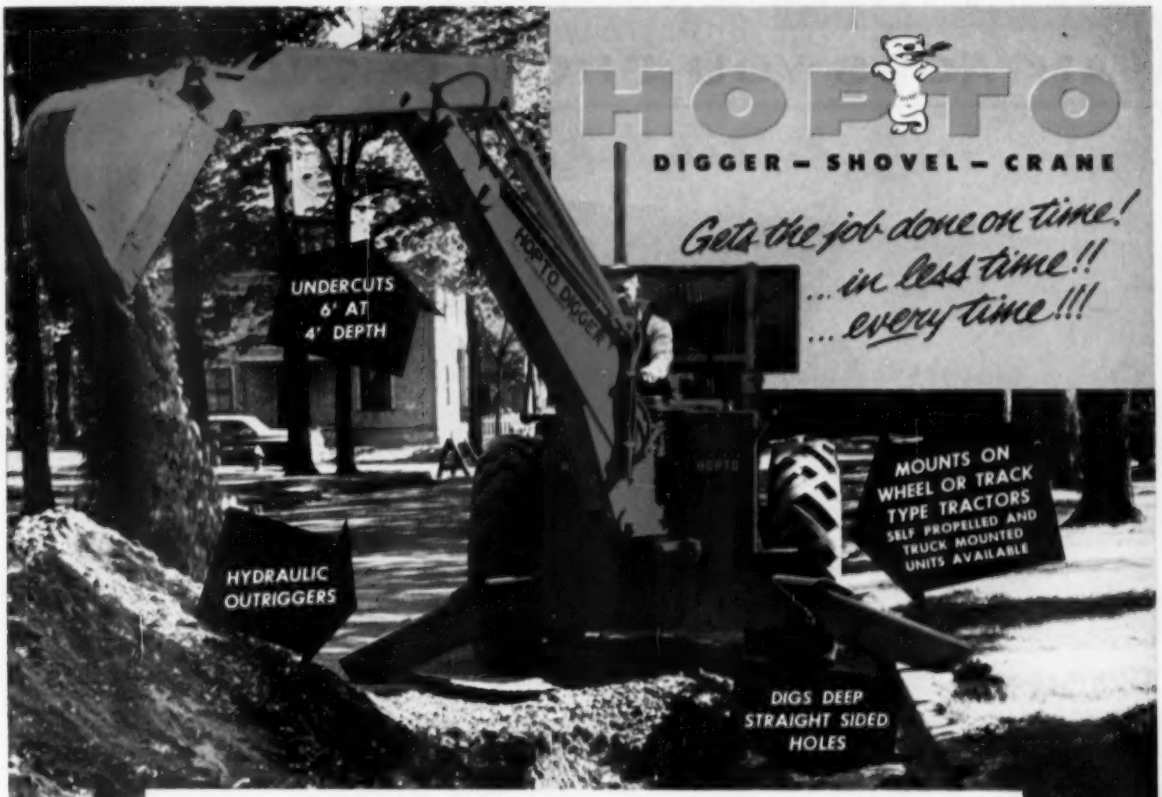
One of a series of compilations of thermodynamic and transport properties of gases published by the bureau, this collection of tables covers air, argon, carbon dioxide, carbon monoxide, hydrogen, nitrogen, oxygen, and steam.

Tables are given at close temperature intervals for the thermodynamic and transport properties of the gases covered. Also tabulated are the vapor pressures and transport properties, thermal conductivity, viscosity, and Prandtl number.

ACCIDENT PREVENTION MANUAL FOR INDUSTRIAL OPERATIONS — Published by the National Bureau of Standards, 425 N. Michigan Ave., Chicago 11. Price, $13.50; 1341 pages.

This third edition of the manual, which is designed as the basic text for the safety man's shelf, includes all the information needed to organize a comprehensive safety program and keep it going. In addition, there are many informative chapters covering the specific types of hazards found in most industrial operations.

Included is technical information on such subjects as pressure vessels, handling materials, conveyors, machine tools, welding, portable power tools, electrical hazards, flammable liquids, etc. The new edition contains 43 sections—17 of them completely new and the others extensively revised and brought up to date.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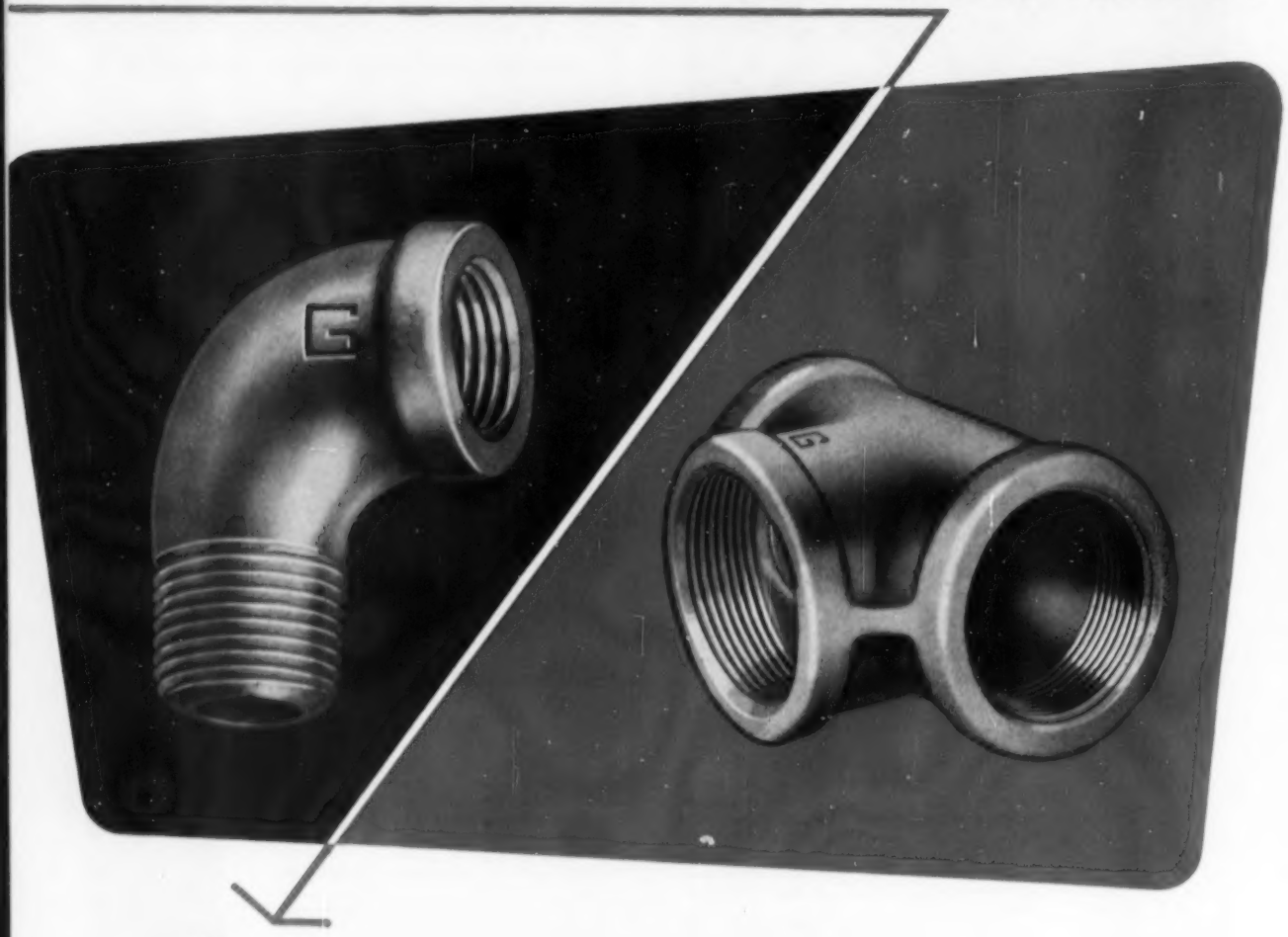

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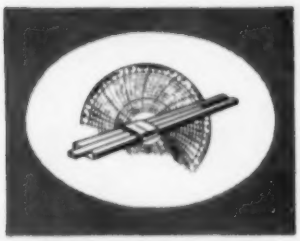

• By GUY CORFIELD

Fracturing dense underground formations

Fracturing or cracking the formation at the bottom or at the production zone of oil or gas wells, to obtain more rapid production, is not a new procedure but a comparatively recent modification has been successful in the dry gas area of Farmington, N. M., where gas is produced from a hard cemented sandstone of low permeability. The fracturing process consists of cementing the bottom of the casing, perforating it at the indicated production zone, and then pumping down a selected sand-water mixture. Injection pressures of 500 to 1000 psig have been used, and the essential technique is to pump at a sifficiently rapid rate to prevent the sand from settling out of the water.

After the sand-water mixture has been forced through the perforations in the casing and into the surrounding structure, it is followed by water injection only to drive the sand as far as possible into the formation. After plugging off, the next zone above can be similarly treated, and so one. By such treatment gas wells with initial potential production of 500 Mcf/day have been increased to 10 MMcf and in one instance to 15 MMcf/day.

Petrochemicals

Anyone wishing to review the status of petrochemicals, and the contributribution that natural gas makes to this mushrooming industry, is advised to obtain a copy of *Petroleum Engineer* for December 1955. This issue features a "1955 Petrochemical Handbook" of 88 pages covering raw materials, processes and future production estimates.

The principal raw materials currently being used are natural gas, LPG, refinery off-gas and residual fuel oils. About 1% of the total petroleum production goes into petrochemicals, but this is expected to reach 2.5% by 1975. Approximately 5% of the natural gas produced goes to petroleum refining and petrochemicals, and this is expected to continue even though the price of natural gas may rise. The plants using LPG are considered to be in the best position because supplies are increasing and prices may drop somewhat. Refinery off-gas will find increasing use, and heavy fuel oil or residual oil will continue to be attractive raw material for many manufacturers.

Major products from natural gas are ethylene (1.4 billion lbs in 1954), ammonia (400,000 tons in 1954), methanol (135 million gals. in 1955), acetylene (100,000 tons in 1954), and methyl chloride, methylene chloride and carbon tetrachloride (425 million pounds in 1954). These chemicals has a value of $523 million.

In spite of this booming production, and demand for petroleum sources, it is stated that competing raw materials such as coal, coke, wood, sugar, etc. can never be overlooked. Improved furnaces for production of calcium carbide from coke have permitted expansion of acetylene facilities at low-cost power locations. Low-pressure hydrogenation of coal is now being developed and can yield a wide variety of aromatic chemicals in large tonnage. Synthesis gas processes have been improved recently by duPont and Texaco so that synthesis gas for ammonia or synthetic fuels can be produced from coal or coke as readily and economically as from petroleum or natural gas. Therefore, a manufacturer interested in petrochemicals must check not only alternate processes, but competing raw materials and end products also.

Microballoons

Microballoons are tiny hollow plastic spheres, ranging in diameter from 0.0002 to 0.0036 in., filled with inert nitrogen gas. They were developed, and the name trademarked, about two years ago by Standard Oil Co. of Ohio; Bakelite Co. of New York and Colton Chemical Co. of Cleveland were licensed to produce them. The initial use was as a flotation layer, on the top of oil storage tanks, to prevent evaporation.

These "balloons" can be made from a variety of plastic materials, and their use is being explored as a light-weight filler for plaster and concrete. They can also be bonded together with suitable binders to form wallboard, floor covering and ceiling tile, and as such have excellent thermal insulating quality. Furthermore, they can be bonded into a light but uniform and strong "foam" with a density of 10-14 lb/cu ft (water weighs 62.5 lb/cu ft). This foam can be used for insulation in air conditioning and refrigeration apparatus, and for reinforcing boat hulls, strengthening airplane wings, etc.

Underwater "hot tap"

An interesting operation has been described whereby a "hot tap," or connection under pressure, was made on a 10-in. gathering line at a depth of 25 ft under water, 30 miles offshore on the Gulf Coast, to tie in production from a new well.

A caisson was constructed in the form of a cylinder 30 ft long, of 6-ft by 8-ft elliptical cross section, split in half longitudinally hinged at the top, shaped at the bottom to clamp around the pipe, and with all joints fitted with sponge-rubber seals. H-beam piles were driven on four corners to provide vertical support and to prevent the caisson from stressing the pipe due to current and wave movement and buoyancy. After installing, with the aid of divers, the caisson was pumped out and the hot tap made in the conventional manner. The connection was completed by bringing a riser above water level, terminating with a valve, and permanently locating and protecting by a 6-ft square miniature offshore drilling platform.

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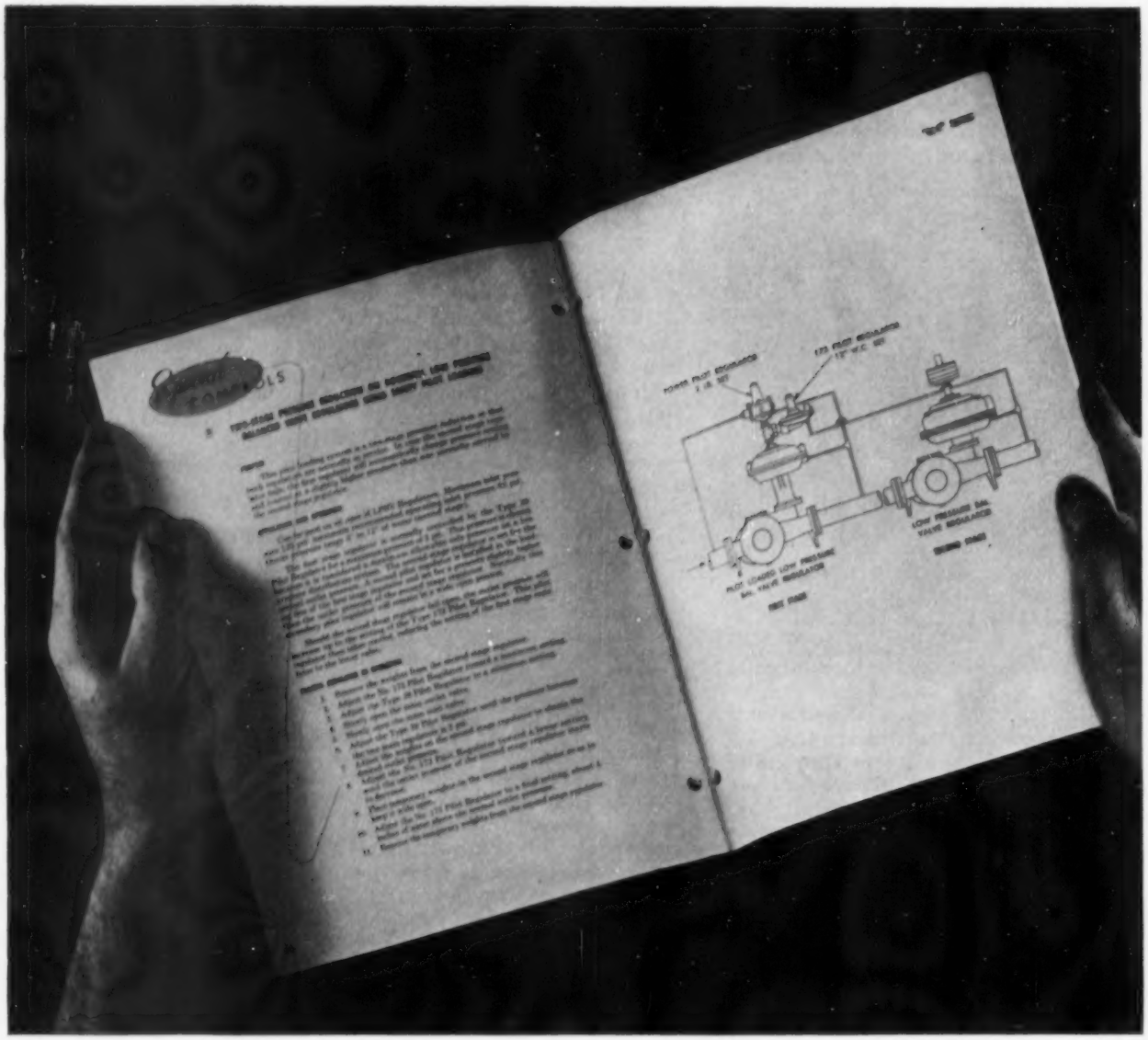

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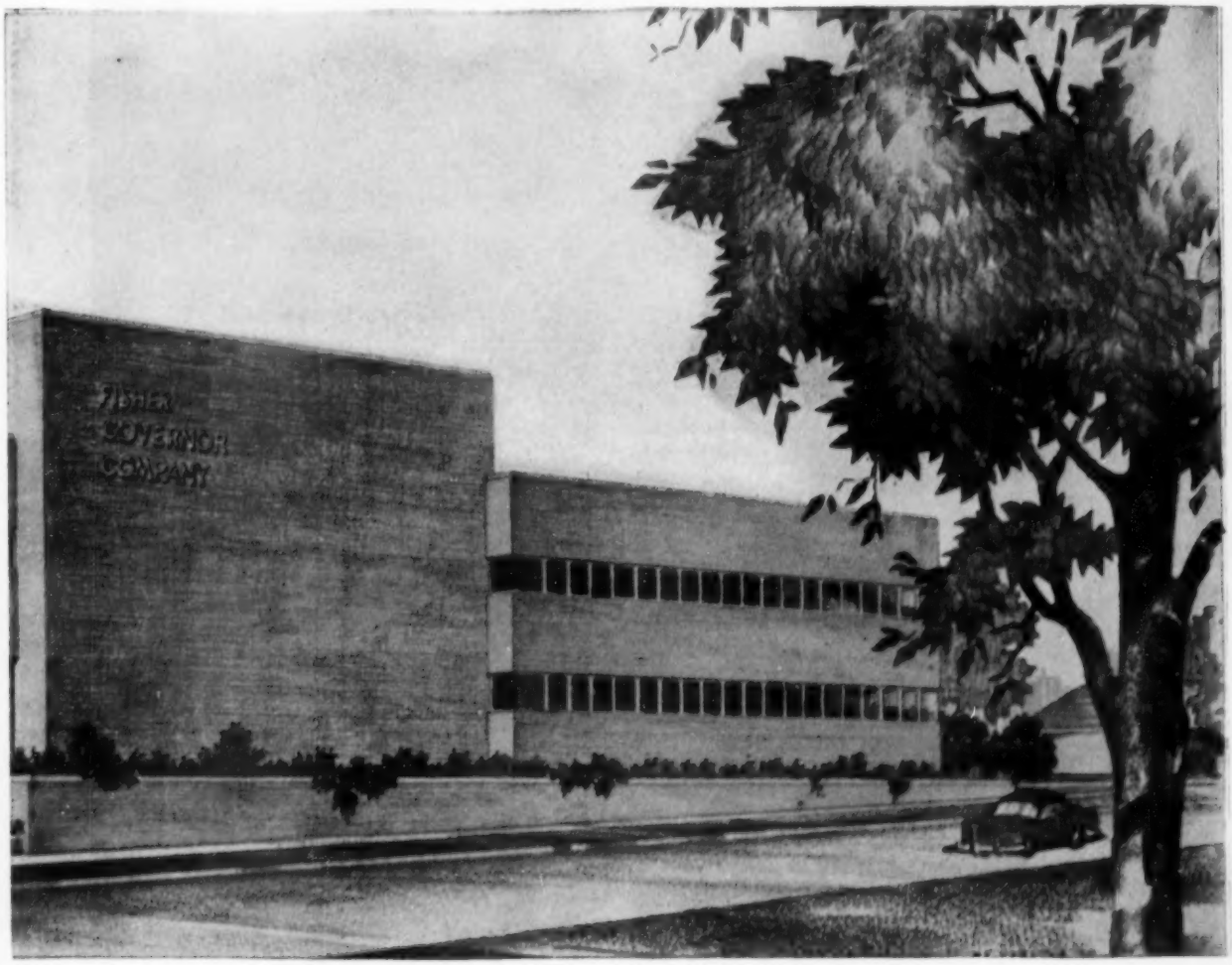

CUSTOMERS WHO BUY FOR

Photo: F.P.G.

This is Richmond, the Capital City of Virginia.

Bettmann Archive

This is Richmond as the city looked about 100 years ago.

MODERNIZED cast iron

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RICHMOND, VA., installed cast iron gas mains 100 years ago... and still installs them.

The Richmond Gas Works (now a unit of the Department of Public Utilities) was completed in February 1851 and by March 1st streets were lighted and some of the "principal" stores, hotels and homes were using gas for illumination. On July 1, 1954 there were 532.28 miles of pipe in service of which 502.54 miles were cast iron.

The Richmond Gas Works has been buying cast iron pipe for more than a century. So have public utilities in more than sixty cities in the United States and Canada. Such customers, in any industry, are rare indeed. They must have a compelling reason. They do. They have proof – *sure knowledge* – of the long life, reliability and tax-saving economy of cast iron pipe.

Cast iron pipe has been a rugged, long-lived product from the earliest days. Today's *modernized* cast iron pipe, centrifugally cast, is even stronger, tougher, and more uniform in quality.

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This cast iron main laid in Richmond in 1851 is still functioning after more than a century of service.

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If corrosion is costing you money in pipe lines, here's the pipe that will virtually eliminate this problem.

It's Republic's SRK®—the rubber-resin pipe that's rapidly becoming a favorite in handling natural gas, oil, brine, water—and many other liquids.

Immune to electrolytic action, acidic and alkaline soils, Republic SRK is also highly resistant to a whole host of corrosive chemicals. Furthermore, it contains a black pigment that makes it resistant to deterioration from the sun's ultraviolet rays.

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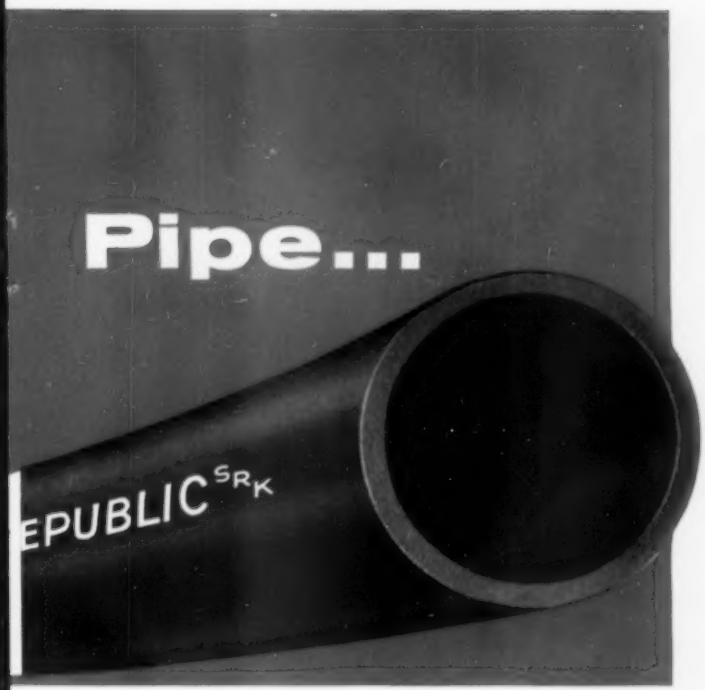


out of Corrosion

supplied in 200-foot continuous coils. SRB is sufficiently flexible to permit threading through existing lines after digging access hole at the main. Rate of flow remains high because internal friction is extremely low. Smooth interior surface resists scale accumulation, minimizes clogging.

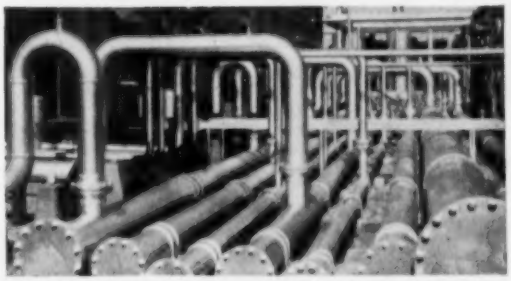
Semi-Rigid Plastic Pipe combines easily with steel. Republic has available a complete line of solvent-welded, sleeve-type fittings for making up any type of piping arrangement, whether plastic to plastic or plastic to steel.

Republic manufactures SRK in ½" to 6" sizes according to specifications recommended by the AGA subcommittee on plastic pipe. Both SRK and SRB are also available in a wide variety of sizes and schedules. It will pay you to investigate Republic Semi-Rigid Plastic Pipe. *To get the complete story, send coupon today.*

STEEL

and Steel Products

These Republic Money Savers take the bite out of costs . . .



Gas at 500 PSI puts the pressure on the alloy studs and high carbon hex nuts in these headers. But they're built to withstand the most severe heat, pressure and corrosive conditions. Clean, accurate threads provide easy tightening, maximum holding power, resistance to wear, trouble-free backoff. Ask your distributor or send coupon for details.

For big pipeline reliability, Republic Line Pipe is known throughout the industry. Electric Fusion Weld (24" through 30" O.D.) welds rapidly due to constant circumference. There are no delays searching for true-fitting ends. And high ductility assures smooth, uniform bends every time. Here's a good money-saving investment. Send for facts.

Economical Truscon® Steel Buildings erect quickly and easily. They're fire-resistant, well-lighted, properly ventilated, easy to maintain—in all, perfect for your requirements. The building shown above is one of many standard sizes and styles produced by Republic's Truscon Division — world's largest manufacturer of steel building products.

REPUBLIC STEEL CORPORATION
Dept. C-1538
3134 East 45th Street
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Please send me more information on:

☐ Plastic Pipe ☐ Fasteners
☐ Line Pipe ☐ Steel Buildings

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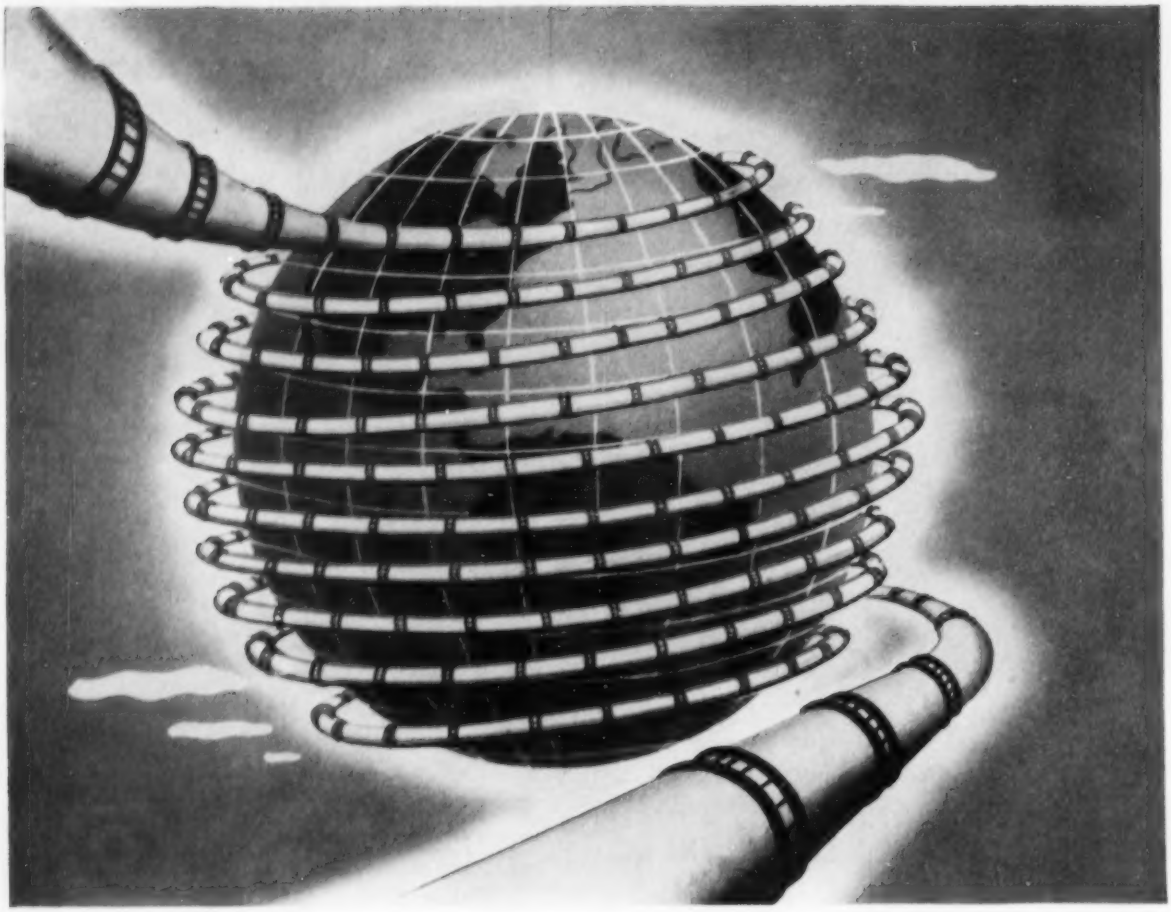

HALF A MILLION MILES FROM MALTA

Back in the 1880's, the by-product of oil—natural gas—was usually flared at the wells. The leaky, threaded-joint pipe lines of that day made it impossible to transport gas under pressure.

This waste so disturbed Solomon R. Dresser, a Bradford, Pa., oilfield manufacturer, that he set out to perfect a truly gastight pipe joint.

Having pioneered in the use of rubber to cap oilwells, he developed an amazingly tough rubber compound. Around this he built his coupling, designed so that when the bolts were tightened, the rubber gasket compressed and formed an absolutely gastight seal.

To prove its worth, he bought a gas well and built a 5-inch, 4-mile pipe line to Malta, Ohio . . . and later to McConnelsville across the Muskingum River. Recently, parts of the Malta line were inspected by Dresser engineers. The rubber gaskets compressed in the couplings were still lively, the couplings still gastight.

Since Malta, more than half a million miles of pipe have been protected with leakproof Dresser Couplings. If this were a continuous pipe line, it would stretch, gastight, 20 times around the world.

DRESSER® ONE OF THE DRESSER INDUSTRIES

FITTING PARTNER FOR THE GAS INDUSTRY

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa. Warehouses: 1121 Rothwell St., Houston; 101 S. Airport Blvd., S. San Francisco. Sales Offices also in: New York, Philadelphia, Chicago, Atlanta, Denver. In Canada: Toronto, Calgary.

FULL SPEED AHEAD, AT AN EASY 1400 RPM: The 5 hp air motor of this Ka-Mo drill, here used to tunnel street intersection for a utility line, uses 110 cfm of 100 lb. air to work at full efficiency. To supply this demand, the Jaeger "125" Roto never had to operate faster than an easy, fuel-saving, engine-saving 1400 rpm.

Jaeger "125" Rotary . . . *a more efficient source of portable power*

Because faster-acting controls more closely regulate its engine and compressor unit, the Jaeger Roto Air-Plus® maintains *constant* 100 lbs. air pressure under any demand up to 125 cfm. Operates two 80 lb. breakers, or a 5 hp. earth drill, at their full efficiency. Because it is the most efficient rotary yet developed, air is produced at slower engine speeds (only 1700 rpm full load speed) with proportionate economy in fuel and wear. Tool boxes hold full set of tools, fuel tank holds full 8 hours' supply.

Jaeger Rotaries are built in sizes to 600 cfm. For complete data or demonstration, call your Jaeger distributor or send for catalog JCR5.

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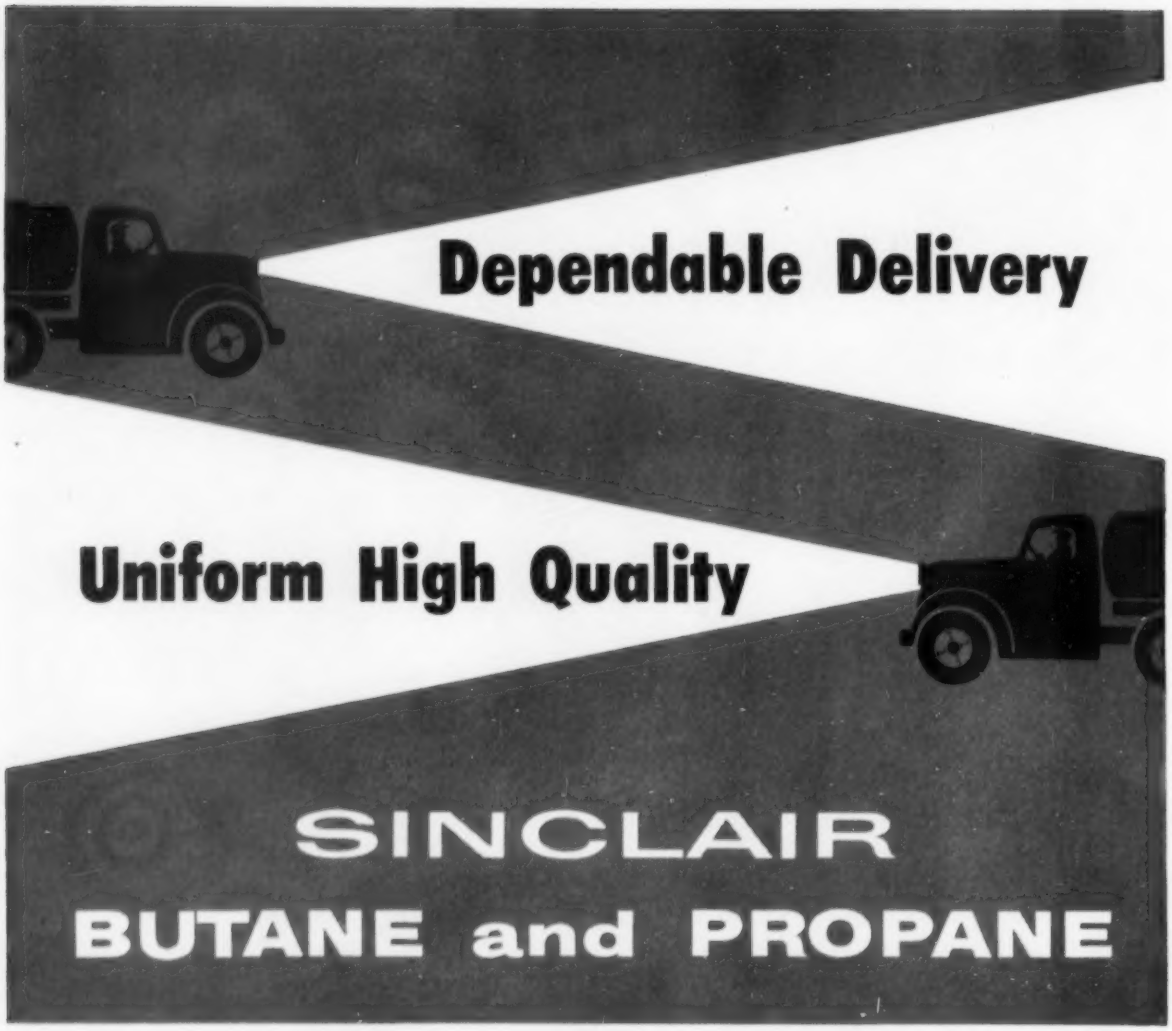
Puts full wallop into two 80 lb. breakers



● Reliability of supply is of prime importance to users of LP Gas. And over the years they've learned they can *depend* on Sinclair's vast production and distribution facilities to meet LP supply requirements . . . *where* and *when* these supplies are required.

Moreover, Sinclair LP is the gas with high heating value . . . with moisture and impurities removed. Its uniform high quality means more efficient, trouble-free operation from your LP Gas installations. You can use Sinclair Butane and Propane with confidence.

To assist you in solving any problems involved in your Butane or Propane installations, Sinclair engineers are at your service. Get the full story on how it will pay you to specify *Sinclair* by calling or writing to . . .

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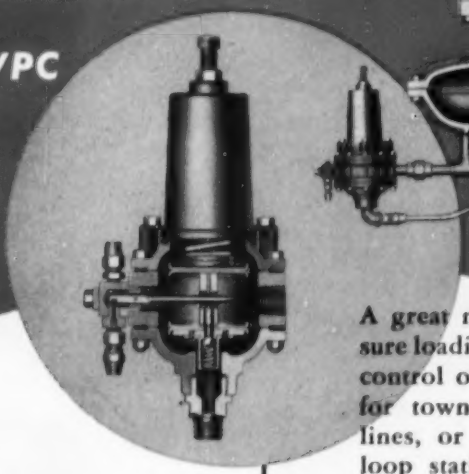
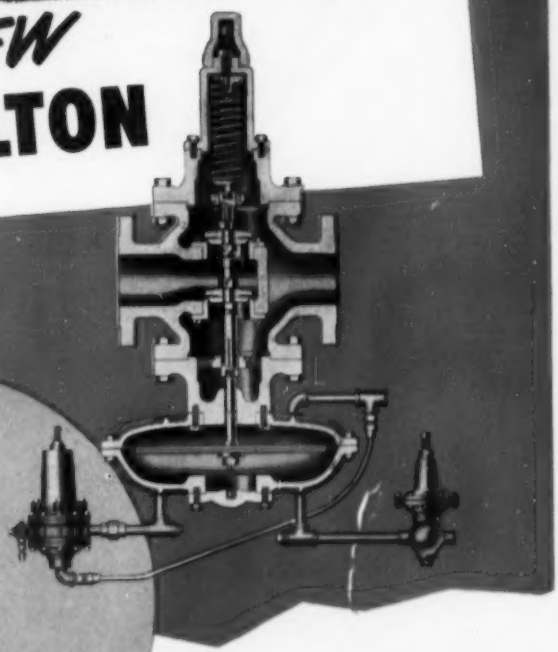
New Precision Control

WITH THE *NEW* CHAPLIN · FULTON

TYPE 51

VARIABLE PRESSURE PILOT and MODEL 44 VPC PRESSURE REGULATOR





A great new team—using pilot pressure loading—to insure stable accurate control over entire flow range. Ideal for town borders, compressor fuel lines, or high pressure distribution loop stations. Built for service—designed for safety.

Totally enclosed, all flanged construction. No atmospheric bleed. Regulator closes on failure. Adequate relief protection against overpressure. Compact installation. Simplified maintenance.

TESTED ACCURACY Proven variable pressure loading—provided by Type 51 Pilot—guarantees accurate outlet control.

WIDE COVERAGE Sizes 2"-12". Inlet pressure to 600 psi or 1200 with cast steel; outlet range ounces to 300 psi.

BUILT-IN SAFETY Totally enclosed. No external bleed. Internal parts under compression—you can't lose a valve or shear a stem. Diaphragms protected by relief valves against overpressure. Safe for pits or vaults with remote pilot provision.

SIMPLY SERVICED Wearing parts in regulator and pilot readily accessible. Without disturbing piping or diaphragm assembly, valves in both are quickly removable for inspection or replacement. Flanged removable seats. Interchangeable valves—hard or soft seats—reduced sizes. No pins or locknuts to adjust.

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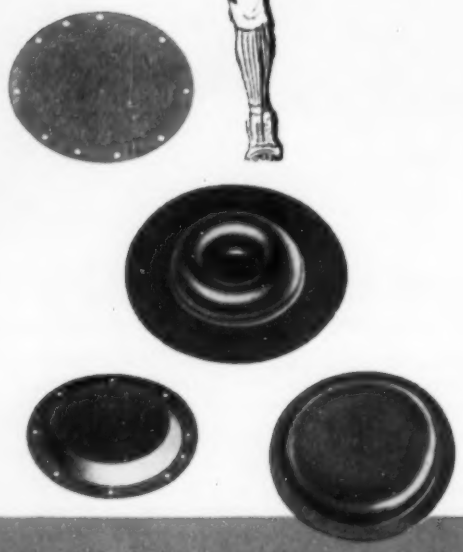
Kissed or KICKED

Whether lightly kissed by low pressure variation or kicked by high pressure gas, Vulcan diaphragms always react as they should . . . instantly, accurately, reliably. Field service records of Vulcan Synthetic Diaphragms prove that resilience, strength and impermeability are retained after long years of service and millions of cubic feet displacement. 8 out of 10 regulators and controls today utilize Synthetic Diaphragms.—Do yours?



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Complete Line of Industrial Coated Fabrics

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Uranium miner, James T. Gray looks over his Le Roi Model 210 Airmaster compresser, which cost him only 40¢ for repairs last year.

View of James T. Gray's uranium mine located far back on Colorado Plateau. Le Roi Model 210 Airmaster compressor, shown in background, provides air power for operation.

How 55% of Uranium Miners On Colorado Plateau Cut Air-Power Costs

One miner spent only 40¢ on compressor repairs in year.

Use of LPG fuel means additional savings in time and money.

Latest reports show that 55% of the compressors sold on the Colorado Plateau are Le Roi — the dependable air compressor. Le Roi-Cleveland air legs and rock drills were also selected to help keep costs down on most of these uranium projects.

Take the case of miner James T. Gray, for instance. Even though he's a long way back in the mountains, far from repair parts, downtime and distance don't worry him. One reason is that last year he spent only 40 cents for repairs on his major source of power—a Le Roi Model 210 Airmaster Compressor.

Six cents a gallon fuel savings provide another cost-cutting factor at Jim Gray's uranium mine. This large saving is possible because he runs the Le Roi compressor on liquid propane gas. In a year, the six-cents-per-gallon saving grows into a respectable total.

Dependable fuel supply and bulk purchases give miner Gray further dollar savings. To eliminate dangers of being cut off from fuel supply, he installed an LPG storage tank and hooked it directly to the air compressor. Once a month he fills the storage tank with LPG fuel. From this supply, he gets a steady, reliable flow of fuel for at least 30 days — an important advantage on mining projects far back on the craggy, Colorado Plateau. It's time saving, too, because it eliminates the need for daily refueling of the compressor tank.

Both the engine and compressor in the Model 210 Airmaster are manufactured by Le Roi. This assures you complete dependability and more economy. Le Roi Airmaster Compressors also have removable, copper-finned, individual radiator and intercooler core sections, for efficient cooling under all operating conditions. 100% interchangeable valves are readily accessible for quick, easy maintenance.

Le Roi Division of Westinghouse Air Brake Co., Milwaukee 1, Wisconsin also manufactures Tractair and stationary air compressors, air tools, and engines. Write today for information about any of these products.

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To executives of all public utilities:

GET YOUR FREE COPY OF THIS NEW BOOKLET

"New Horizons In Public Service"

This new 40-page, illustrated booklet presents a comprehensive demonstration of the most modern business methods, machines and record systems...*in actual operation*...in one of America's oldest and most outstanding Public Utilities. Don't miss the detailed story showing how this great utility was completely revitalized... how efficient record controls have been proved in use... how its customers are now provided with the *finest and most modern, convenient, economical, friendly and dependable SERVICE.*

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New Horizons in customer services is the result... with all manner of attendant benefits. The Customer Service Center with centralization of related records is unique and makes for *fast, accurate, efficient* service... new and simpler procedures... elimination of unnecessary paper work... establishment of well-defined departmental responsibilities ... high employee morale.

Every phase of utility operation is covered in this valuable book: Redistricting, Meter Reading, Customer Service Location Record, Customer History Record, Credit and Collection Department, Unit Bookkeeping Department, General Accounting Department, and so on.

Get this new, illustrated booklet on Public Utilities *now.* Simply write on your letterhead to Remington Rand, Room 1340, 315 Fourth Avenue, New York 10 and ask for X1534 —"New Horizons In Public Service."

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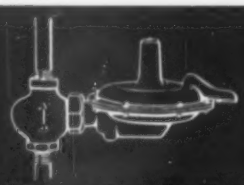
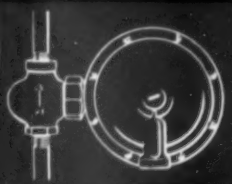
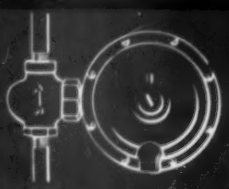


SERIES 1401 Inverted Vent—prevents collection of foreign material . . . screened.

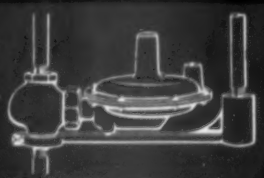


SERIES 1402 Vertical Diaphragm—Vertical Vent—large area screened vent prevents collection of water or foreign material on diaphragm.



SERIES 1403 Horizontal Vent

SERIES 1444 Mercury Seal—highest safety because of location on regulator head. One vent for diaphragm chamber and seal.



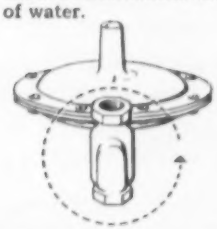
SERIES 1500 Meter Bar—available with 6 inch or 11¼ in. centers. Easily exchanged without disturbing meter.

Meet Every Domestic Service Regulating Need with ... Series 1400

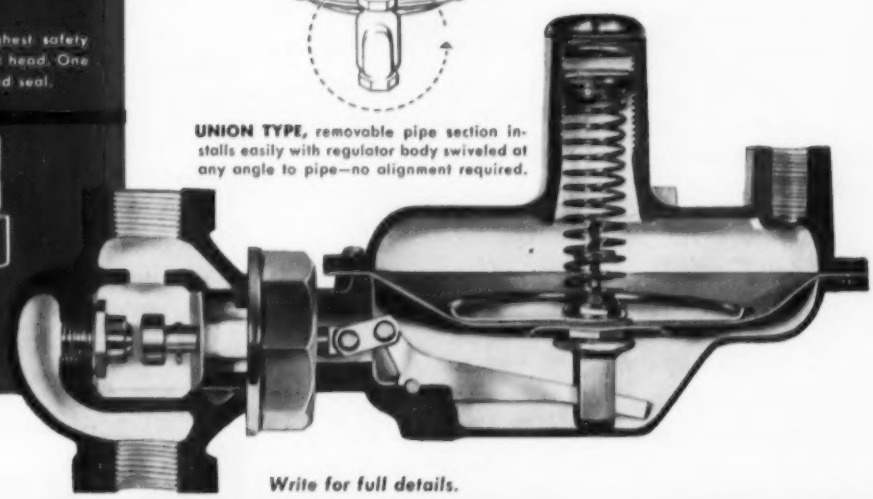
Reliance Regulators

NEW Safety, Accuracy, Economy

- **LARGE AREA PASSAGES** from the orifice to the vent outlet for emergency gas escape in case of excess pressure
- **STURDY NECK SECTION** helps assure efficient, smooth, compounding action.
- **FOR INLET PRESSURES** to 100 lbs. per square inch.
- **DIE-CAST** aluminum body and top.
- **RUGGED CONSTRUCTION**—no installation damage to exposed parts.
- **BUILT-IN** mechanical relief valve set to relieve at 14 inches of water.



UNION TYPE, removable pipe section installs easily with regulator body swiveled at any angle to pipe—no alignment required.



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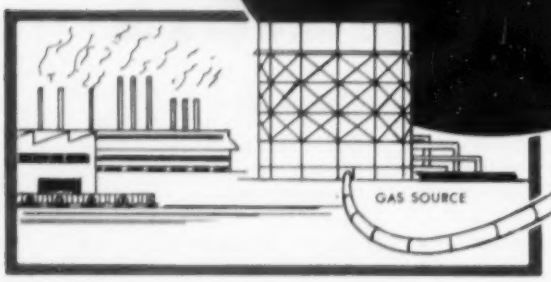
AMERICAN METER CO. EST. 1836

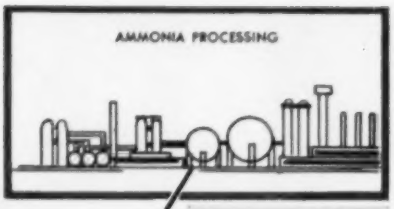
AMERICAN METER COMPANY

INCORPORATED (ESTABLISHED 1836)

In Gas Service...

American for an American "First"





American Double-X Mechanical Joint Pipe, centrifugally cast in 20-foot lengths, will carry coke-oven gas to the first ammonia plant of its kind in America.

The first plant in America which will produce ammonia from a coke-oven gas base will soon be in operation. Long-lasting, *quality* cast iron pipe was selected for the important gas supply line.

American 16-inch Double-X Mechanical Joint Pipe will conduct 17,500,000 cubic feet of coke-oven gas per day to this plant from a source two miles away. Because of plant and source locations, numerous installation problems were met.

Besides the problem of heavy dolomitic limestone in the line route, the additional problems of a creek crossing, and a railroad crossing with an eight-hour time limit for pipe installation were faced. Installation of three pipe lines in one trench helped solve these problems.

American Cast Iron Pipe Company research and facilities are helping solve piping problems in many of today's growing industries and communities. Get our recommendations when you plan *your* installation.

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Tubing of Tenite saves on maintenance

NOT AFFECTED BY ELECTROLYTIC OR CORROSIVE ACTION OF SOIL

When you use tubing of Tenite Butyrate plastic in gas service installations, you go a long way towards eliminating maintenance problems and their heavy cost. Tubing made of this Eastman plastic successfully resists the corrosive action of soils. It is a non-conductor of electricity; therefore it is free from electrolytic attack. Even the joints need no protection, eliminating hot asphalt and its hazards. Result: long years of trouble-free service for your installations.

Tubing of Tenite plastic also speeds replacement of corroded metal service lines. No trenching is needed. Holes are dug only at the main tap and the service riser, and the tubing is run right through the old pipe.

You'll find tubing of Tenite Butyrate has other important advantages, too: It cuts readily with a hand saw; joins quickly with slip-sleeve couplings and solvent cement. And easy-to-use adaptors make leak-proof connections between tubing and metal pipe.

Tubing of Tenite Butyrate has been cutting maintenance costs, as well as reducing original installation time, for utilities since 1943. It can do the same for you. Write for the names of distributors near you. Ask, too, for literature describing the tubing, its fittings, and installation methods in gas service applications. Address: EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

A 16mm. sound-color film, "PLASTIC PIPELINES," is available upon request.

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BUTYRATE
an Eastman plastic

At a huge new sports stadium in Minnesota...

"SCOTCHRAP" rolls on easy ...even in zero weather!

"Scotchrap" conforms smoothly, handles easily at high or low temperature — and the pressure-sensitive adhesive sticks tight, too — even at 0°-10°F!

Johnson, Drake & Piper, Inc., General Contractors on the new Metropolitan Sports Stadium near Minneapolis, Minnesota, prefer "Scotchrap" Brand Pipe Insulation for these reasons — and many more. You see, there's no danger when applying "Scotchrap". No special equipment is needed. Just roll it on, and corrosion is sealed out.

"Scotchrap" is a tough vinyl plastic tape that resists abrasion above or below ground, resists galvanic and electrolytic action, resists damage from oil, water, acids, alkalies, weathering and sunlight. *Make sure you get the tape with the green adhesive.*

Sold by the square in 1″, 2″, 4″, 6″ and 8″ widths — 100-foot rolls. Order a supply today!

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SCOTCHRAP Pipe Insulation

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The term "SCOTCHRAP" is a registered trademark of Minnesota Mining and Manufacturing Company, St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

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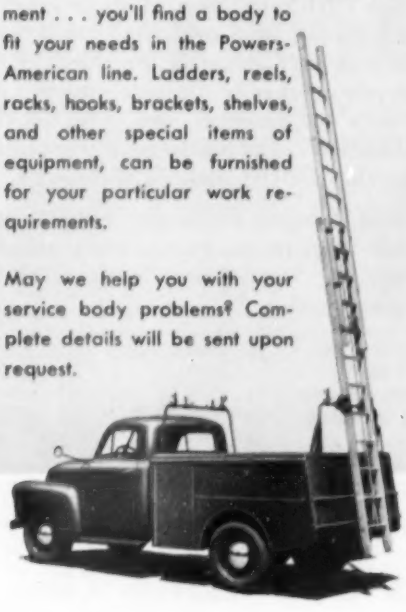
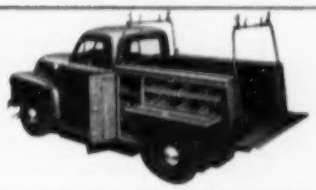
The 1 Source
for utility bodies and equipment!

If your work calls for one service body or a hundred . . . if you can use standardized units or require custom-made equipment . . . you'll find a body to fit your needs in the Powers-American line. Ladders, reels, racks, hooks, brackets, shelves, and other special items of equipment, can be furnished for your particular work requirements.

May we help you with your service body problems? Complete details will be sent upon request.



Series 44L and Series 44 (shown above) designed for any general service work. Fully-equipped with shelves and bins. For ½, ¾, 1, and 1½ ton chassis.



Series 25T and 35T arranged for telephone installation and service. Widely used in other phases of utility work. Available in ½ and ¾ ton sizes.

Series 25M and 35M used for all types of general service. Especially suitable for electric meter installation and maintenance. Models for ½ ton and ¾ ton vehicles.

Series 25G and 35G designed for use in the installation and servicing of gas meters. Equipped with meter hold-downs, bins, and pipe rack. In ½ and ¾ ton sizes.

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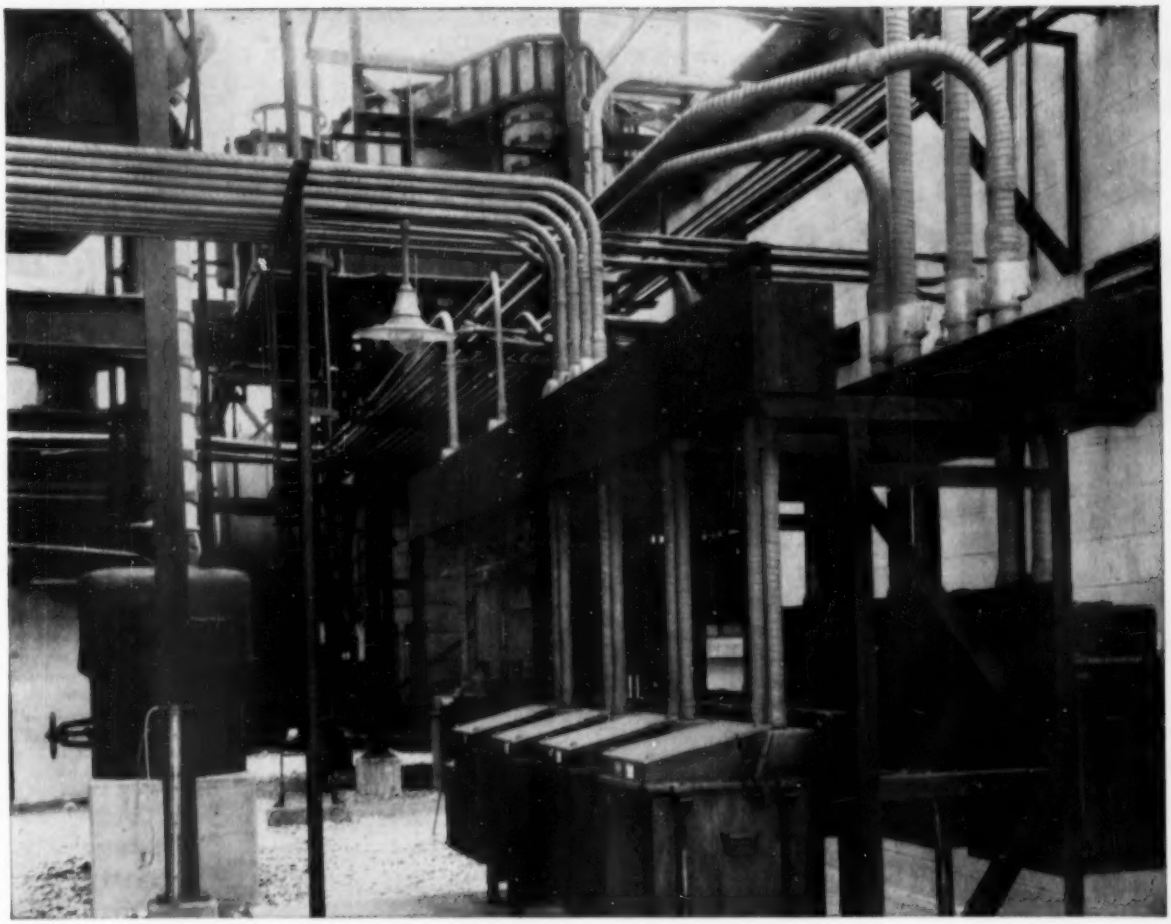
Prompt Service from our expert, specially trained engineers, competent office force, strategically located warehouses and reliable shipping service.

Don't delay . . .
phone, wire or
write us today.

NATURAL GAS ODORIZING CO., INC.

P. O. BOX 15252 HOUSTON 20, TEXAS



Polyken® protective coating beats corrosion in this sulphuric acid plant

They're using durable Polyken Tape *to protect electrical conduit in and around the cooling tower*

The Switch Box and Controller Station you see here is located at the cooling tower of Gulf Oil's Port Arthur, Texas, sulphuric acid plant. As you know, where there's sulphuric acid, there's a big need for protection against corrosion.

Formerly, they used paint on the electrical conduit. That lasted only three or four months.

But *Polyken* Protective Coating has kept the conduit in excellent condition since 1953. The tape itself is in excellent condition, too.

Polyken Tape gives dependable protection because it's manufactured from controlled raw materials under controlled conditions. Its tough polyethylene backing offers high electrical insulation resistance, high resistance to corrosive action.

Just as important, *Polyken* Protective Tape Coatings go on right from the roll. The thick adhesive mass provides strong adhesion to cylindrical surfaces and a self-seal at the lap. That means faster, more effective, lower-cost application—when it's put on and in the long run. Send the coupon or see catalog in Sweets Industrial File, Sec. 6c/Ke.

Polyken®

CONTROLLED STRENGTH

PROTECTIVE COATINGS

THE KENDALL CO., POLYKEN SALES DIVISION

Polyken, Dept. G-C
222 West Adams St., Chicago 6, Illinois

Please send me samples and further information on *POLYKEN* PROTECTIVE TAPE COATINGS.

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CORROSION RESISTANT VINYL PIPE IS LIGHT WEIGHT, EASILY JOINED

PIPE OF B. F. GOODRICH CHEMICAL RIGID GEON CUTS INSTALLATION TIME

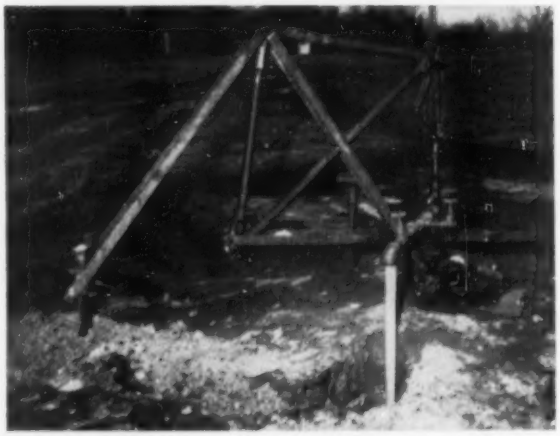
CORROSION resistant rigid vinyl plastic pipe, made from B. F. Goodrich Chemical Company's Geon resin, was installed recently in an Oklahoma oil field to handle crude oil in a water-flood system. Located in Alluwe Field, northeast of Tulsa, the rigid Geon vinyl pipe is used as a gathering line to join 20 oil wells to a main three-inch vinyl line leading to the tank battery.

It takes two men just one hour to join 640 feet of this corrosion resistant rigid vinyl pipe. This compares to three or four hours that it takes to install comparable steel pipe or ten hours for cement-lined pipe.

One man places the pipe in position and cleans any moisture and dirt from the ends of the pipe. The other applies the solvent cement with a brush and the two men push two pipes together in a slip-sleeve fitting. The whole joining operation takes less than a minute for each section.

The usual steel pipes failed in this case in three years from sulfur and salt corrosion. Geon rigid vinyl is immune to galvanic corrosion—and highly resistant to both salt water and sour crude oil. Greater fluid flow of rigid vinyl pipe reduces operating pressures. The line carries 6,000 to 7,500 barrels per day here.

For further information on the many uses of Geon vinyls, please write Dept. DM-2, B. F. Goodrich Chemical Company, Rose Bldg., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.



Rigid Geon vinyl pipe connects to a brass valve at wellhead. These feeder lines then lead into the 3-inch main line. About 6100 feet of 1½ inch and 1200 feet of 2-inch pipe in 11 lead-in lines join 20 oil wells in this system. About 1800 feet of 3-inch pipe was used for the main line.

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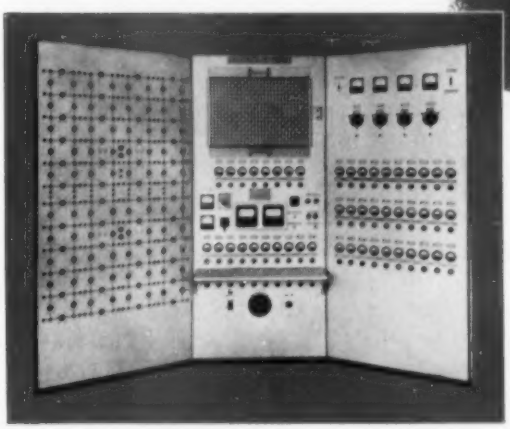

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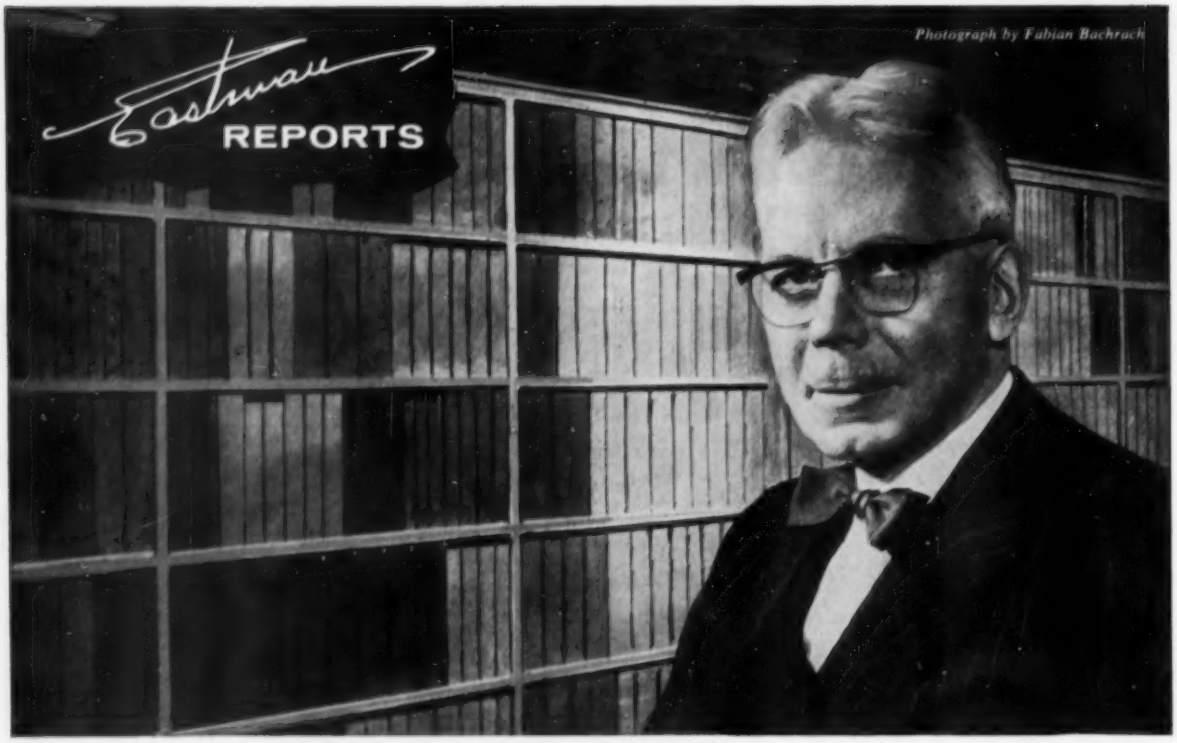

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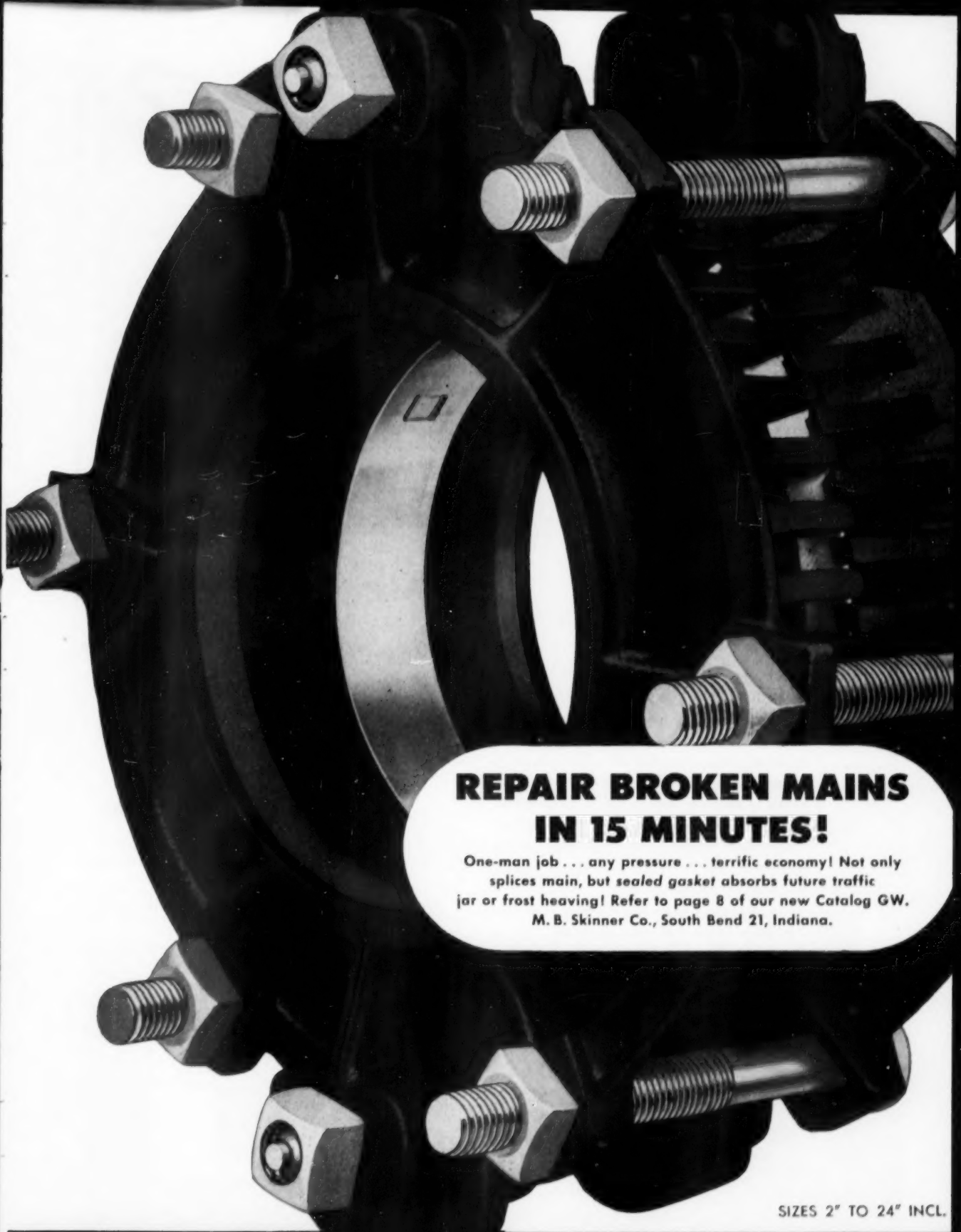

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Corrosion and Plastic Pipe Section

During the month of the National Association of Corrosion Engineers' convention, corrosion prevention techniques and plastic piping matters again take the spotlight in the gas industry.

GAS

MARCH 1956

A survey of the personnel and administrative side of corrosion control

PERSONNEL and administrative matters associated with the formation and promulgation of corrosion control programs in the gas industry have not been so thoroughly analyzed as have the technical aspects of the science of corrosion prevention. GAS surveyed distribution and transmission companies in the industry to round-up opinions on the people required and their qualifications, over-all costs, equipment used, and organization of the industry's corrosion control groups.

Do most gas companies have corrosion control programs?

The number of classifications of companies participating in the survey are shown on *Table 1*. One of the first trends to become evident was the indication that the pipeline companies and the utilities with large numbers of meters seem to have better developed and staffed corrosion control groups. This is, of course, not surprising as it follows the modern industrial swing toward specialization within large companies. *Fig. 1* relates the influence the number of customers has to the percentage of gas companies in each classification that reported having formal corrosion control programs.

Are separate corrosion staffs used?

Most gas companies have set up separate staffs to handle corrosion control administration and application. Again, the percentage is smaller in the case of the smaller companies—about 31% of the distribution companies with less than 25,000 customers have a corrosion prevention department or section, while 100% of the same type of companies with

TABLE 1. COMPANIES PARTICIPATING IN SURVEY

Size of companies, by customers	Number of companies reporting	Transmission lines under protection, % of total lines in each class	Distribution mains under protection, % of total mains in each class	Rectifiers used, summation by class	Sacrificial anodes used, summation by class
Utilities					
to 25,000	29	5	6	32	12,462
25,000 to 50,000	23	47	14	250	10,003
50,000 to 100,000	20	42	15	334	62,883
100,000 to 250,000	19	30	9	364	32,420
250,000 to 500,000	9	24	18	96	229,583
Over 500,000	7	12	5	152	78,350
Transmission	18	34	—	1649	59,210

GAS staff report

GAS presents a nationwide survey into organizational and policy matters concerning corrosion control. Can your company profit from the operating methods of corrosion control programs in other companies?

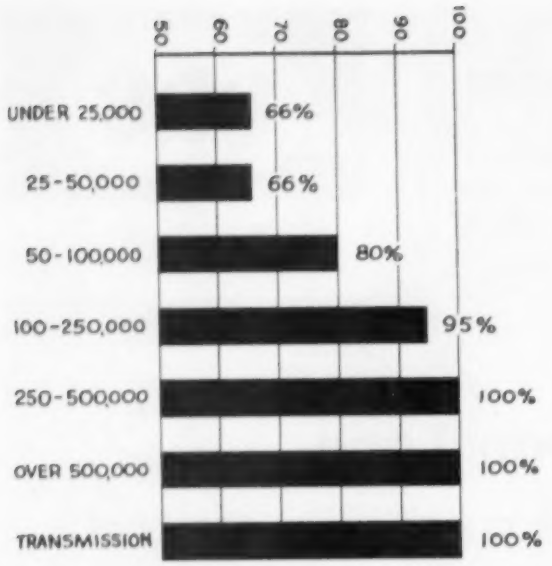


Fig. 1. Influence the number of customers has to the percentage of gas companies in each classification that reported having formal corrosion control programs.

more than 250,000 customers have separated this function. Seventy-two per cent of the 18 gas tranmission companies reporting have a separate corrosion prevention group.

In general, the smaller companies use staff engineers on a part-time basis for corrosion work. Often, this engineer will require the services of an outside consultant and such expert supervision is retained as needed. As the companies enlarge, corrosion control generally becomes a more specialized job and is departmentalized.

Is a full-time corrosion engineer in charge?

The chart on *Fig. 2* shows the percentage of companies, under each classification, that have a full time corrosion engineer and the percentage that have a staff assisting the corrosion engineer. The size of the staffs seems to have little relation to anything except possibly the length of time a company has been working with a corrosion mitigation plan. Many gas companies have just started formal, planned corrosion reduction work in the last three years and they have not had the time and money to develop complete staffs.

Train, or hire experienced corrosion personnel?

Most of the companies participating in GAS' corrosion survey indicate that they would like to hire college-trained engineers with corrosion prevention experience, but they have found that qualified men of this definition are virtually unavailable, so the answer has been to use engineers with little or no corrosion control experience and train them in the work. In the representative group of gas companies surveyed, there are 157 graduate engineers working full-time on corrosion and 39 in the same classification who spend part-time on corrosion work. The utility companies employ 98 of the engineers full-time and the transmission group has 59. In the part-time classification, the gas utilities have 39 engineers and the transmission companies one.

The transmission companies employ 43 full-time skilled technicians while the distribution companies have 142 full-time and six part-time people in this classification. Most of these are high school graduates who have shown aptitude for corrosion work and have been trained under the direction of the corrosion engineer.

One company has had success with assigning engineers to work in the field with consultants on their property for the purpose of learning corrosion engineering; however, only one of these individuals is currently doing corrosion work. There is the advantage of having these engineers with limited experience available for "hot shot" work. Another company (77,500 customers) has a training program whereby all of its cadet engineers spend a number of months working with the corrosion engineer .

We have found that some of the corrosion engineers have been able to train themselves by contact with consultants, reading texts and journals on the subject, and taking short courses that are available to the industry through NACE-sponsored projects. They, in turn, can better understand the job of bringing along engineers who are selected to specialize in this work as the corrosion control program for their company develops.

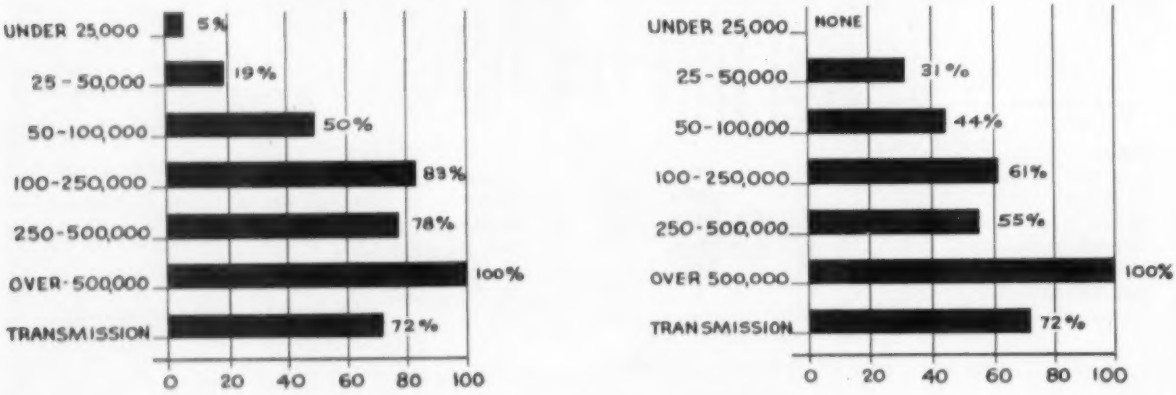


Fig. 2. Percentage of companies having full-time corrosion engineer (left) and percentage having a staff assisting the corrosion engineer (right).

TABLE 2. SIZE OF CATHODIC PROTECTION SECTION AND PERSONNEL

Type of company	Under cathodic protection: Transmission lines, miles	Distribution mains, miles	No. of corrosion engineers	No. of skilled technicians	No. of others
A. Dist. & Trans.	790	405	2	1	4
B. Dist.	—	234	1	5	5
C. Dist. & Trans.	160	35	3	3	0
D. Dist.	—	110	1	1	—
E. Dist.	—	190	1	1	—
F. Dist. & Trans.	49.5	400	1	2	1
G. Dist.	—	116	5	2	3
H. Dist. & Trans.	304	707	4	2	—
I. Dist.	—	450	4	4	2*
J. Dist. & Trans.	1600	1140	1	24	—
K. Dist.	—	790	6	4	6
L. Dist. & Trans.	155	760	0	11	10
M. Dist. & Trans.	288	435	11	8	3
N. Dist. & Trans.	228	760	1	2	4*
O. Trans.	5000	—	25	25	—
P. Trans.	1550	—	3	3	—
Q. Trans.	1300	—	4	0	—
R. Trans.	1600	—	3	1	—
S. Trans.	1970	—	3	1	3
T. Trans.	1509	—	2	2	—
U. Trans.	2000	—	4	—	1
V. Trans.	1500	—	1	8	—

*Summer only or part-time.

One distribution company (approximately 200,000 customers) reported that it has been unsuccessful in attempts to hire engineers with experience in corrosion work. As a result, all of the corrosion prevention section personnel have been trained after employment. This company's experience was duplicated again and again in the survey. One eastern company with over a million meters made the flat statement that, ". . . there are no trained corrosion engineers available."

The survey indicated to us that the growth of corrosion prevention as a specialized science for all industry has far outstripped the supply of engineers who have experience and training in the technology. This is in line with the general shortage of engineers and skilled specialists for technical work, in general, with which the whole nation is seemingly faced. Are our industry's organizations and the special organizations of the corrosion groups adequately planning to increase the supply of engineers with some training and/or experience in corrosion?

In the pipeline companies we find that a company (5000 miles of pipelines) reports ". . . We train young engineering graduates to handle gas measurement and corrosion control duties. Then they are given a district in which they are responsible for these two duties." Another company (major pipeline) has been able to hire one experienced corrosion engineer, but had to train two other engineers for this work. About 27% of the pipeline companies try to hire experienced corrosion engineers as a matter of policy, while the other 73% hire graduate engineers and train them for corrosion sections. One of the smaller transmission companies contracts all of its cathodic protection surveys and construction.

Both utilities and transmission companies use skilled technicians for a variety of corrosion control work, and construction labor is used as needed on major installation or service work. Most of the time, the labor comes from the district or division in which the work is being done. Some typical examples of the size of cathodic protection sections and the relationship between corrosion engineers, skilled technicians, and other personnel is given in *Table 2*.

Who administers corrosion control programs?

Table 3 shows the extent of responsibility the corrosion engineers have in the determination of nature, extent, and cost of the corrosion control program. These data are correlated in groupings by the number of customers served, to give an idea of the size relationships. The corrosion engineers and their staffs are responsible for the studies and recommendations relating to the corrosion control activities; but, in most cases, the final authority on costs and the extent of the programs are in the hands of management; a central engineering staff; or a distribution, pipeline, or general superintendent. Also, in the majority of companies the corrosion section or department integrates its activities with those for the various other departments in the planning stage, so the final planning is a group decision. Another trend indicated that the central corrosion prevention staff will handle the technical supervision of plans to alleviate corrosion problems and the application of the plans is often left to divisional or local groups.

In some companies the central corrosion prevention staff will handle the design and application of cathodic protection to solve a corrosion problem classed as large, but when the problem involves relatively small anode installations the division personnel will make the actual application and it will be checked out by personnel from the central staff.

One of the most important concepts to emerge from the survey indicates that although the central corrosion control staff does the research and standardization of corrosion prevention techniques, there is a feeling the operational side of the program should be in the field with district or divisional staffs. Many companies indicated they would like to have a trained corrosion engineer on each field staff who would be

TABLE 3. EXTENT OF CORROSION ENGINEERS RESPONSIBILITY

Size of company, by customers	Corrosion engineer determines nature, extent, cost of corrosion control program, % of total in each class	Others determine, etc.
To 25,000	37	63
25,000 to 50,000	63	37
50,000 to 100,000	56	44
100,000 to 250,000	67	33
250,000 to 500,000	56	44
Over 500,000	72	28
Transmission	56	44

TABLE 4. RESPONSIBILITIES OF CORROSION PREVENTION SECTIONS

Size of company, by customers	Cathodic protection system design, %	Cathodic protection installation, %	Inspection of cathodic protection installation, %	Pipe coatings and specifications, %
To 25,000	37	37	47	47
25,000 to 50,000	63	32	63	50
50,000 to 100,000	88	69	88	63
100,000 to 250,000	100	67	94	50
250,000 to 500,000	78	67	89	78
Over 500,000	100	43	86	57
Transmission	89	67	89	39

completely responsible for corrosion control in a respective area. Many companies operate under this policy and more would like to initiate this set-up when they have developed enough trained corrosion engineers or technicians to go around. In operating under this policy, personnel from the central staff are available for consultation and recommendation, and, at times, take to the field for technical supervision of large or particularly intricate jobs. Some companies use the central staff for constant rotational testing and checking of the effectiveness of corrosion prevention techniques in the various divisions. They have the operational corrosion engineers plan and apply the protection in their own areas.

What are a corrosion prevention section's responsibilities?

Table 4 gives an indication of the responsibilities of the corrosion prevention sections in the surveyed companies. It indicates that the corrosion engineer and, through him, the corrosion staff has the least responsibility for: (1) supervision of cathodic protection system installations, and (2) pipe coatings and specifications. The corrosion section may do quite a bit of inspecting of the completed installation, but the actual installation work is usually done under the supervision of the department from which the labor is requisitioned.

The determination of standards for pipe coating is usually a general engineering responsibility. Much of the coating work is, of course, done at mills or coating yards, or by trained distribution and pipeline crews. Inspection for compliance with coating standards is usually a function of general engineers, chemical engineers, and/or electrical engineers. This does not mean that the corrosion engineer does not have an important part in the formation of the coating standards and the control of the application. The engineer or standardization group making the specifications relys on the corrosion engineer's experience and, in many cases, simply lend the final authority to his recommendations. The corrosion engineer will often analyze the inspection reports whether done by company forces or by contract inspection agencies.

Who handles inter-company interference problems?

The corrosion engineers are the representatives of their companies when inter-company interference problems arise. There is a sprinkling of companies who leave this type of problem to the chief engineer, or the superintendent of distribution or pipeline.

On the question of inter-company interference, there is every indication that this type of problem is increasing at a serious rate. Many of the surveyed companies say municipal improvements, underground construction, and general con-

TABLE 5. FACTORS DETERMINING APPLICATION OF CATHODIC PROTECTION

UTILITY COMPANIES		PIPELINE COMPANIES
Transmission Lines	Mains	
1. Soil characteristics.	1. Soil characteristics.	1. Preventive maintenance.
2. Preventive maintenance.	2. Leakage.	2. Importance of the line.
3. Leakage.	3. Preventive maintenance.	3. Soil characteristics.
4. Importance of the line.	4. Importance of the line.	4. Leakage.
5. Age of the pipe.	5. Age of the pipe.	5. Age of the pipe.
6. Diameter of the pipe.	6. Diameter of the pipe.	6. Diameter of the pipe.

struction is being carried on at such a rate that stray currents and shorting contacts increase while they are in the process of eliminating those known. Some cities, or really groups within these cities, have formed organizations composed of representatives from the several companies that have or may be affected by underground structures. These organizations serve as clearing houses for dissemination of information on pending underground construction and the elimination of contacts. They are cooperative efforts and have worked out well—perhaps there should be more of them.

What factors determine the application of cathodic protection?

Table 5 shows the factors that determine the application of cathodic protection. Again, the companies answering the survey and indicating that they use cathodic protection systems in their corrosion control program, have been grouped according to the number of customers served to give a comparison of their relative size. The factors, in the order of their importance, that determine when and where cathodic protection should be used are shown in *Table 5*.

What types of vehicles are used in corrosion work?

Vehicles used by the corrosion control groups are many and varied. The station wagon is preferred by most companies. Typically, the vehicles are equipped with mobile radio and have special compartments built in for carrying instruments and equipment. Compartments are usually padded to protect the instruments. *Table 6* shows the vehicular set-up of some selected companies.

Investigation of the data resulting from the survey indicates most corrosion sections check their rectifiers monthly. A few make their routine checks semi-monthly. Very few, relatively speaking, use a longer term for rectifier checks.

The cathodic protection systems employing rectifier-driven anodes or ground beds are checked either semi-monthly or annually. Semi-annually has a silght edge.

The effectiveness of sacrificial anode installations is checked annually by a majority of the companies. Some corrosion engineers will check new anode installations monthly for three months or make one check three months after installation. Then, they usually go back to an annual basis. We found that a number of companies are compiling histories on specific installations and are then making frequent checks in areas where histories indicate early failure is likely. They tend to lengthen check periods in areas where histories reveal troubles are infrequent. Other companies use random sampling techniques for checking and have found this system works out pretty well.

Conclusion

The striking conclusion that we draw from the data supplied by the companies participating in the corrosion survey is that corrosion prevention as a science and separate entity has not been given the attention, time, and money that it perhaps deserves. The corrosion departments seem to be "third hands" that have just grown as the necessity increased. Too often, they are offshoots rather than recognized vital parts. However, the progress to date has been particularly strong in the last five years and corrosion activities seem to be well on their way toward an established place in most of the gas companies. ■

TABLE 6. VEHICULAR SET-UP

Type of company	Panel Trucks	Passenger cars	Station wagons	Pickup trucks	Other	Equipped with
1. Utility		1			1 power wagon	Radio & auger
2. Utility		1	1	1	1 power auger	Radio
					1 carryall	Padded cabinets
3. Utility				6		Utility bodies
4. Utility	4	1				Radio, generator connections
5. Utility			2			
6. Utility		9		9		Water tanks, tool bins
7. Utility		2	2	4		Utility bodies on pickups
8. Utility	5	1		3		
9. Utility			3			
10. Utility		1	1	1		
11. Utility		1		3		Cable & wire, instruments & barricades
12. Utility		2	3			
13. Utility			2			
14. Utility			4			
15. Utility		1		5	1 2-ton truck	
16. Utility	2	1			1 2½-ton truck	
17. Utility	2		1			
18. Utility		1		1		Utility body on pickup
19. Utility			2	1	1 jeep	Jeep equipped to install ground beds
20. Utility		5		5		Utility bodies on pickups
21. Trans.			25			
22. Trans.			4			
23. Trans.			3	1	3 carryalls	Radios
24. Trans.		4				
25. Trans.					2 organic	1 earth auger & 1 ribbon plow
26. Trans.			2			Radio
27. Trans.		1	2			Radio

Training—the key to an effective cathodic protection system

By T. R. STILLEY*, Field Service Manager • Electrical-Mechanical division, Good-All Electric Mfg. Co., Ogallala, Neb., and
W. H. HOBBS, Superintendent Gas Distribution • Illinois Power Co.

MANY gas distribution companies are now experiencing high leakage mitigation costs to maintain systems which were installed during past years without corrosion control. Management now usually recognizes that costs can be reduced and service improved through an orderly corrosion control program. Management wants to know, however, how much corrosion control will cost and how the program can be organized and executed.

The shortage of corrosion engineering personnel has delayed the initiation of corrosion control programs with many companies. The purpose of this report is to show how a complete program can be initiated in a short time with a minimum of experienced corrosion engineering personnel.

Illinois Power Co. serves approximately 165,000 gas customers in 58 towns. The organization is divided into 12 service areas with an engineering staff in each area. The headquarters office has a gas engineering staff which handles such functions as training, standards, general supervision, and approximately 5% of the detail engineering. The remaining engineering work is performed by the area engineering personnel. *Fig. 1* shows a chart of the above organization.

Fig. 1. Illinois Power Co.'s corrosion control program operates under the organization shown on chart. There are 12 service areas serving the company's 165,000 gas customers.

Cost of a corrosion control program

An investigation showed that complete corrosion control could be applied at an initial cost of approximately 16% of the original cost of the piping, or an equivalent annual operating cost equal to 2.0% of the original cost. The annual expenditure for mitigation of leakage caused by corrosion was more than 2% of the original cost; therefore, the corrosion control program was justified even without consideration of loss of product, excessive depreciation, hazards, and other indirect costs.

A breakdown of the initial costs of a complete corrosion control is as follows:

a. Coatings 12%
b. Cathodic protection 1.6%
c. Engineering 1.4%
d. Training and miscellaneous 1%

The above figures are percentages of the original cost of piping.

Scope of the corrosion control program

On the basis of the above, a corrosion control program was adopted which included the following:

a. All engineering and construction work to be handled in the same manner as other gas operations, with most of the details being handled by the service area personnel and the general supervision from the headquarters staff.

b. Complete coating and cathodic protection of all new steel piping.

c. No protection of cast iron pipe except control of stray currents.

d. A change of material specifications to reduce corrosion.

e. Cathodic protection of exsiting steel piping where it could be economically justified.

The corrosion engineer was the only one in the company who was familiar with corrosion control practices; therefore, the obvious need was for standards showing every detail and a complete training program.

Training

All personnel connected with gas operations were included in an initial training program which consisted of four sessions of 2 hr. each.

*Formerly, gas corrosion and standards engineer, Illinois Power Co., Decatur, Ill.

PART I

The basis of corrosion and its prevention

I Introduction

(1) Definition of corrosion: tendency of metals to change back to the original "ore" state as found in nature; usually this process means that the metal leaves the pure state and combines chemically with oxygen, nitrogen, sulfur, or carbon.

(2) Definition of erosion: the mechanical wearing away of metal by friction, abrasion, or other means; not necessarily accompanied by chemical changes.

II The mechanism of corrosion

The galvanic principle as a preliminary to the study of underground corrosion of metals.

(1) What is electricity? Why should the corrosion worker be interested?

(2) Components of a galvanic cell.
- (a) Cathode
- (b) Anode
- (c) Solution (may be soil or sea water acting as a solution).

(3) Types of galvanic cells.
- (a) Different metals—same solution (see *Table I*).
- (b) Same metal — differences in solution.
- (c) Same metal — separates into anodes and cathodes on surface because of variations in surroundings: 1, mill scale; 2, variations in oxygen content in solution; 3, solution differences; 4, cinders; 5, old and new metals (such as new pipe attached to old pipe, or bright threads on old fittings); etc.

(4) The shorted galvanic cell.
- (a) A pipe, ship hull, or other structure acting as a shorted cell under solution differences.
- (b) Two or more metals in contact and in a soil or solution.
- (c) Removal of metal by the action of the shorted cell.

(5) Examples of corrosion and the importance thereof.
- (a) Underground pipelines.
- (b) Hot water heaters.
- (c) Steam condensers.
- (d) Tanks sitting on ground, or buried in ground.
- (e) Underground cable systems and substation or tower grounding systems.
- (f) Ship hulls and docks.
- (g) Industrial and processing structures.
- (h) Underground tanks and tank bottoms.
- (i) Piping in and under concrete (slab homes).

(6) The *Dollars and Cents* importance of corrosion.
- (a) Direct dollars lost.
- (b) Indirect dollars lost.

III Methods of corrosion control

(1) Coatings
- (a) Purpose of
- (b) Types of
- (c) Methods of application of

(2) Changing soil or solution surroundings.
- (a) Fills; sand; gravel; increasing resistivity.
- (b) Drainage.
- (c) Re-routing structures.
- (d) Modification of solution.

(3) Removing causes when due to more than one metal in a solution.
- (a) Re-design of structure.
- (b) Insulation between metals.

(4) Cathodic protection.
- (a) Principles and methods of.
- (b) Its relation to coatings.

TABLE I—POTENTIALS IN VOLTS REFERRED TO HYDROGEN

Gold	+ 1.300
Silver	+ 0.800
Mercury	+ 0.799
Copper	+ 0.339
Tin	+ 0.138
Hydrogen	0.000 (zero reference)
Iron (3)	— 0.045
Lead	— 0.127
Nickel	— 0.141
Iron (2)	— 0.441
Zinc	— 0.76
Aluminum	— 1.70
Magnesium	— 2.34

NOTE: Usually when two of these metals are placed in a solution the upper one becomes the cathode and the lower one becomes the anode. In most cases the anode will be the corroding member of the pair of metals.

PART II

Coatings

I The objectives of a pipeline coating

(1) To act as an electrical insulator.
- (a) Must *be* a good electrical insulator.
- (b) Must *remain* a good electrical insulator.

(2) A good coating may not be a perfect insulator.
- (a) Too costly.
- (b) Perfect insulation not needed with cathodic protection; but not too many flaws which would increase cost of cathodic protection.

II Characteristics of a good coating

(1) Electrical resistance of the material be high.

(2) Resistance to chemical attack be high.

(3) Ability to form a *bond* to metal surface be good.

(4) Have low water absorption and transmission.

(5) Be sufficiently strong and flexible to withstand mechanical damage from construction and from soil stresses.

(6) Be free from flaws or bubbles—give continuous insulation properties.

(7) Be able to maintain the above characteristics over long periods of time.

III Types of coatings

(1) Microcrystalline waxes (contain inhibitors—lower resistance than others).

(2) Asphalts.

(3) Coal-tars.

(4) Plastics.

(5) Ceramics.

(6) Other coatings (metals, paints, etc.).

IV Applications of coatings

(1) Surface preparation.
- (a) Clean free of grease, oils, paint, rust, dirt, etc.
- (b) Sand-blast or grit-blast to roughen surface and clean surface.
- (c) Prime.

(2) Application methods.
- (a) Field.
- (b) Plant.

(3) Specifications.
- (a) Bond.
- (b) Thickness (1/16 to 1/8 in. is normal for coal tars or asphalts).
- (c) Free from flaws inasmuch as possible in light of costs.
- (d) Wrappers — purpose; mechanical protection only.
- (e) Repair of coating damage—remove old coating to bare metal.

(4) Repair and joint coating materials.
- (a) Hot coats—dope kettles, etc.

CATHODIC PROTECTION CHART
ANODE PROTECTION SYSTEM

	Anode	Street Tee	Bond Wire From Service To Main	Armored Gasket In Couplings and Curb Cock	Insulating Adapter In Meter Riser	Clean Pipe Ends By Filing	Cathodic Protection	
							Mains	Services
New service from new steel main, see Detail "A"	9#	Malleable Tee & Armored Ell	Yes	Yes	Yes	Yes	Yes	Yes
New service from cast iron main, see Detail "B"	5#	Brass Tee and Insulated Ell	No	Yes	Yes	Yes	No	Yes
New service from old (unprotected) steel main, see Detail "C"	5#	Brass Tee and Insulated Ell	No	Yes	Yes	Yes	No	Yes
Partially renewed service, see Detail "D"	5#	--	No	Yes, except use insulating couplings on main end of new section	Yes	Yes	No	Yes, on new section
Renew street tee only, see Detail "E"	5#	Brass Tee and Insulated Ell	No	--	Yes	Yes	No	Yes
Renew service through wall only, see Detail "F"	None	--	No	No	Yes	Yes	No	No
Renew main with steel and tie in old service, see Detail "H"	9#	Malleable Tee & Armored Ell	Yes	Yes	Yes	Yes	Yes	Yes
Renew main with cast iron and tie in old service, see Detail "I"	5#	Brass Tee and Insulated Ell	No	--	Yes	Yes	No	Yes
Leak repair on steel main using leak clamp or renewal of less than 20 ft. of pipe, see Detail "J" & K	17#	--	--	Yes	--	Yes.	Yes	--

Fig. 2.

(b) Cold coats—service cements, plastic tapes.
(c) Semi-hot coats—tapecoat.
(5) Application of plastics and other types.

V Economics of coatings

(1) Cost of materials.
(2) Cost of flaw repairs—coating testing.
(3) Life.

VI Safety rules

(1) Flame hazards, and explosion hazards.
(2) Skin irritation hazards.

PART III

Cathodic Protection

I Review of the galvanic cell action

(1) Anodes and cathodes on pipe surface, ship hulls, or other structures.
(2) Corrosion control by an *external anode* and *power source.*

II Coatings in relation to cathodic protection

(1) Reduction in current required per square foot of surface.
(2) Flaws become cathodes under cathodic protection.
(3) Estimating current requirements.
(a) Bare or partially coated steel: 1 to 3 milliamperes per sq ft is usual amount in soil; 10 ma per sq ft or more in sea water.
(b) Well-coated steel: 0.01 to 0.1 ma per sq ft is usual amount.

III Cathodic protection by galvanic anodes

(1) Materials used—
(a) Magnesium: 1.60 v to $CuSO_4$ open; 0.95 v closed (common value).
(b) Zinc: 1.10 v to $CuSO_4$ open; 0.85 closed (common value).
(c) Aluminum and other materials.
(2) Backfill (in soil applications).
(a) Materials used: bentonite and gypsum, etc.
(b) Purposes of
(1) Retains water and lowers contact and soil resistivity.
(2) Prevents local cell action on anode itself.
(3) Life of anodes.
(a) Depends on materials used.
(b) Depends on current drain.
(c) Depends on amount of useless local cell action on anode.
(4) Location of anodes.
(a) Spacing of anodes and spread of current in soil.
(b) Effect of coated or bare metals on position of anode.
(c) Interference effects.

IV Cathodic protection by rectifiers

(1) Types of rectifiers.
(a) Copper-copper-oxide (seldom used).
(b) Selenium (most used).
(c) D-C generators (almost never used).
(d) New types of rectifiers (germanium; silicon) (very promising for future).
(2) Ground beds.
(a) Scrap steel (good); scrap cast iron (not so good).
(b) Carbon anodes in coke breeze backfill (good).
(c) Silicon-iron alloys (good).
(d) Shape and location of.
(3) Cable systems.
(a) Materials used; copper and aluminum (most used); neoprene, etc.
(b) Connections (cadweld); over-head and underground.
(c) Insulation precautions.
(d) Economic considerations.

V Testing for cathodic protection

(1) Potential tests.
(a) Reference cells; $CuSO_4$ half-cell (why?).
(b) Meters used: special for low energy circuits.
(2) Current tests.
(a) Special ammeters (zero resistance type).
(b) Milli-volt readings along pipe give current by V = IR.
(3) Test leads.
(a) Type of wire: #6, neoprene insulation best; #8 or #10 neoprene or plastic insulation acceptable in some cases.
(b) Connection methods (Ca-welding).

VI Preparation of an underground cable or piping systems for cathodic protection

(1) Coat pipe or cable where possible.
(2) Bond couplings where necessary to obtain continuous circuits.
(a) By brass spring in gaskets.
(b) By cadwelding or brazing a copper cable across coupling.
(3) Insulation of bare and coated lines to seperate systems electrically.
(a) Meter insulation to separate gas and water systems.
(b) Main insulation at coated and bare junctions.
(c) Insulation of curb boxes from coated service lines.

(4) Insulation to separate mains for purposes of measuring currents.
(5) Effect of bare main tied to a system which is coated and cathodically protected.

VII Operation of a coated and cathodically protected system

(1) Periodic tests.
  (a) Potential of pipe-to-soil using reference cell.
  (b) Current output of sources.
  (c) Currents along mains.
  (d) Current density on pipe surfaces (ma/sq ft).
(2) Operating records.
  (a) Importance of.
  (b) Types of reports.
  (c) Use of records.
(3) Maintenance.
  (a) Ground beds.
  (b) Cable connections (watch underground cables to ground bed).
  (c) Rectifiers.
  (d) Test leads.

PART IV

A corrosion manual was prepared and the fourth training session included a discussion of Section 5 (Construction Practices) in the manual. Every detail of each chart and drawing was discussed. *Fig. 2* shows a chart from the manual used to outline the practices for using magnesium anodes and *Fig. 3* shows a typical detail drawing which is referred to in line 1 of *Fig. 2*.

Since the formal meetings, the training program has been continued by field instruction and by talks and demonstrations at regular safety and training meetings.

The following personnel were included in all training:

1. Headquarters engineering staff.
2. Service area engineering staff.
3. Gas superintendents and assistants.
4. Foremen and lead men.
5. Fitters and laborers.

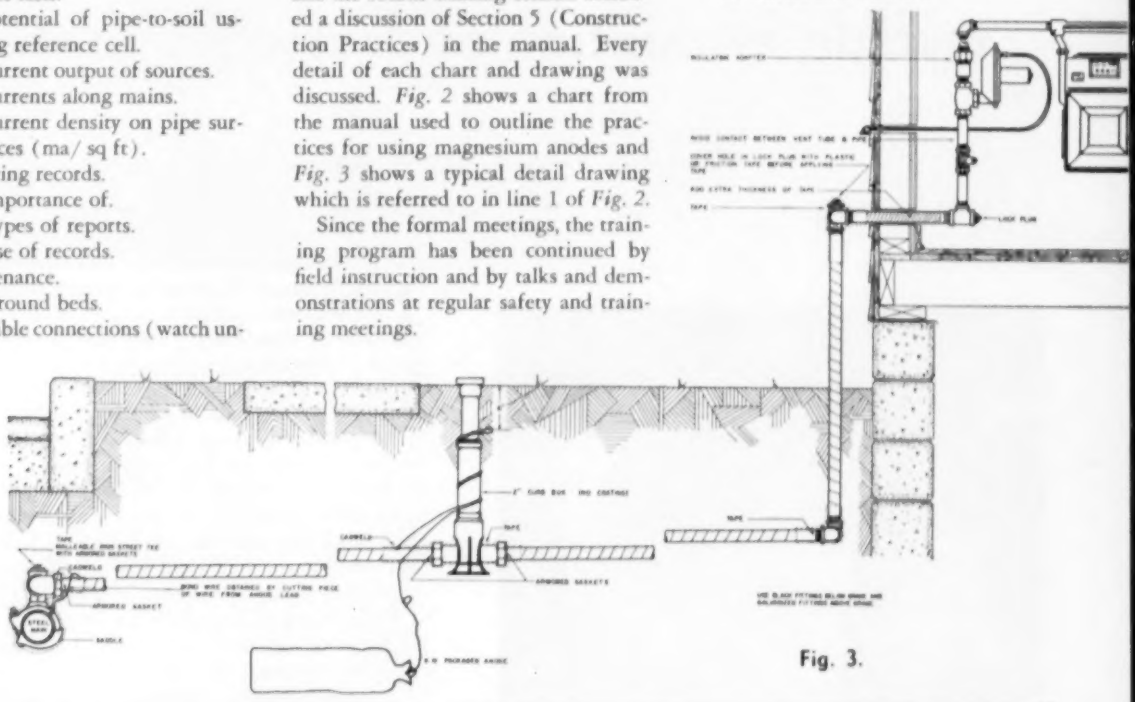


Fig. 3.

Standards

The corrosion manual which was prepared and adopted as a standard for corrosion control at Illinois Power Co. included the following sections:

1. The corrosion story.
2. The electrical and chemical nature of corrosion.
3. Corrosion on gas and electric systems.
4. Corrosion control.
5. Instruments for corrosion control.
6. Construction practices.
7. Maps, records, and miscellaneous.

The manual may be described as being a text and standards manual since the first four sections cover a general discussion, and the last three sections contain detail drawings and instructions for the application of the methods.

Operations

The normal progress of a job which includes some corrosion control aspects would be as follows. A distribution planning study would show that 4000 ft of a 6-in. steel main is needed to serve a new area. The service area engineering staff would lay out the details of the route and prepare a map of same. The map would also show the location of all fittings and other equipment, including cathodic protection aspects such as insulating fittings, rectifier or sacrificial anodes, and test leads. A bill of material would also be prepared and would be submitted along with the map and other associated papers to the headquarters distribution design engineer, the superintendent, and the corrosion engineer. After the headquarters engineering staff has checked the job, it is sent on for approval. All inter-company interference problems are handled by the corrosion engineer.

The corrosion engineer occupies a headquarters staff position and his time is divided approximately as follows:

1. Corrosion training 60%.
2. General supervision of corrosion control work 20%.
3. Preparing standards 10%.
4. Safety and miscellaneous 10%.

Results

The program was initiated with two engineers having corrosion experience, namely the headquarters corrosion engineer and a corrosion consultant, and can be perpetuated by a headquarters corrosion engineer, possibly with the addition of an assistant. The key to the success of this program is adequate training.

The mthods outlined in this article have succeeded in initiating a corrosion control program in a short time and appear to be able to perpetuate same with satisfactory efficiency. ■

ACKNOWLEDGEMENT

The cooperation and assistance of Ray M. Wainwright of the University of Illinois is hereby acknowledged. Professor Wainwright helped to prepare and deliver the training lectures, and to plan and initiate the corrosion control program.

Application of salt crock and soil stress tests in evaluation of protective coatings

By PAUL W. LEWIS, Engineer • Bureau of Reclamation, Denver

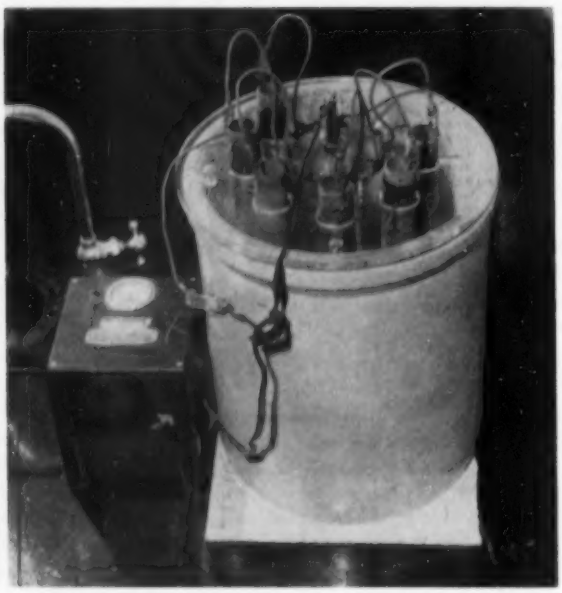


Fig. 1. Salt crock testing apparatus.

Both the AGA and API have used one or both of these tests for measuring performance of the many corrosion materials currently on the market. Here is how the Bureau of Reclamation sets up equipment for these tests in its evaluation work.

THE Bureau of Reclamation, through its water resources development program in the 17 western states, has large quantities of water-bearing steel pipe in service. The protection of these piping systems is of utmost importance. To this end the reclamation laboratories in Denver are endeavoring to keep abreast of the new developments being offered by the protective coating industry. A program of selecting the best coatings for field investigation is made through the laboratory screening of new materials. Since laboratory tests cannot always be correlated with service results, the most promising coatings are evaluated under controlled, field experimental conditions with anticipated replacement of the less suitable materials in future bureau work.

In the choice of coatings for buried piping, three screening tests—the salt crock test, the soil stress test and the indentation test—have been utilized primarily to evaluate various coating materials. Although numerous materials have proven corrosion preventive qualities, it is realized that when wetting and drying clay soils are encountered extra precaution must be taken to preserve their film continuity. In the use of these tests we have attempted to ascertain the merits of a few of the materials being offered to protect steel piping that is buried in earth.

Salt crock test

The salt crock test is primarily used to evaluate the continuity of pipe coatings and wraps. It is a means of measuring the resistance of pipe coatings to current flow and establishing the effectiveness of the coating. The salt crock test has been used by the AGA and API for determining some of the merits of coating materials.

Two types of pipe specimens were tested in the salt crock. The first, consisting of a straight section of 1-in. nom. dia. pipe, represented the condition of either a welded joint or a long straight section of pipe. The second, which included a short straight section with an ell, appropriate nipples, and either a coupling or a union, represented straight sections of pipe joined by fittings. These specimens were partially submerged in a salt solution. Through the use of 6-volt direct current an electrolytic cell was produced with the specimens being made anodic. Breakdown of the coatings under the influence of salt rock conditions was reflected by the resistance offered to the flow of current through the coatings. Resistance measurements were recorded at the start of the test and at monthly intervals thereafter. The salt crock

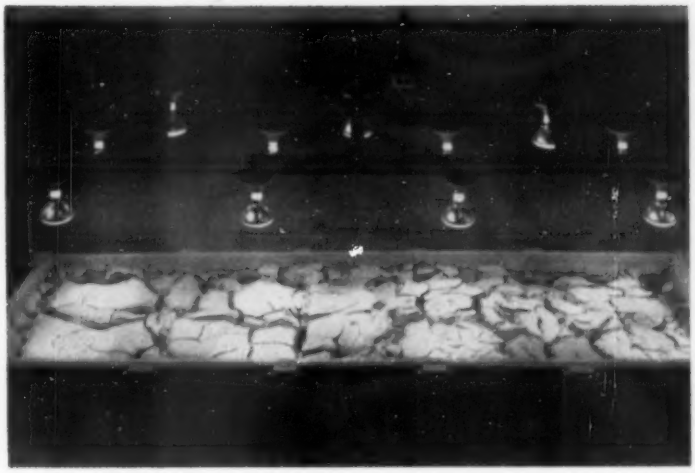


Fig. 2. Soil stress test. Condition of clay after thorough drying.

Fig. 3. Test. Close-up as a result of drying clay soil.

apparatus, as applied to straight sections of pipe, is shown in *Fig. 1*.

Soil stress test

The soil stress test was designed to provide information on the behavior of various exterior pipe coatings and wraps in clay soil subject to alternate wetting and drying, which produces a tendency to crack the coating or pull it off the pipe.

Various coatings were applied to sections of steel pipe 3½ in. OD by 18 in. long. These specimens are placed in a clay slurry in a wooden box, 1 ft x 3 ft x 9.5 ft, lined with galvanized sheeting. A bank of infrared lamps is situated above the box to accelerate drying of the clay by uniform heating of the surface. During the required two weeks' drying period, air is circulated over the surface of the clay by an electric fan. Surface temperature of the clay ranges from 83° to 112° F during this time. Temperature at the top of pipe ranges from 82° to 107° F and at the bottom of the pipe from 77° to 94° F. *Fig. 2* shows the appearance of the clay at the end of the drying cycle and *Fig. 3* shows a close-up of the drying action on the coated specimen.

Specimens were removed from test after they had been exposed to 25 wetting and drying cycles or had failed earlier. It is believed that effective performance through 25 extreme wetting and drying cycles is adequate to indicate satisfactory resistance to severe soil stress conditions. In this connection, soils having a liquid limit of 50 or above and a high plasticity index (above 21) are considered to be capable of exerting severe soil stress. Such soils would be classified as fat clays. Soils having a liquid limit of below 50 are classified as lean clays and are considered to be capable of exerting moderate soil stress. Although the laboratory test was made with a "lean" clay, the thoroughness of the wetting and drying action is thought to make the performance of the coatings in the test roughly comparable to their performance in fat clays under field conditions where wetting and drying would seldom, if ever, be as complete as in the laboratory test.

Indention test

The test used to evaluate the resistance of coatings to puncturing by rocks in backfill is called an "indentation" (see *Fig. 4*). In this test the coatings are subjected to a load of 6.48 lb bearing on 0.049 sq in., the cross-sectional area of the rod. This corresponds to a pressure of 132 psi. The total load is equivalent to the weight of a rock about 5 in. in diameter. The tests were conducted in atmosphere controlled to 73.5° F and 50% relative humidity. The indented area was then electrically detected to determine whether or not damaging perforation of the coating had occurred. With this test, we have been able to make certain evaluations of coating materials for the bureau's use.

Summary

The salt crock and soil stress tests are used by the bureau in the comparative evaluation of coating materials for the protection of buried steel pipe. The salt crock test determines the resistance of the coatings to current flow and thus helps to establish their corrosion prevention properties. The soil stress test exposes the coating to the severe disruption action of clay during dry-out shrinkage and gives a strong indication of their behavior under actual exposure conditions. Both tests are required to complete the evaluation of a pipe coating material.

In selecting a coating for the protection of buried steel piping, not only must an excellent corrosion preventive material be chosen but the wrapping must be adequate to resist the soil conditions to be encountered. ■

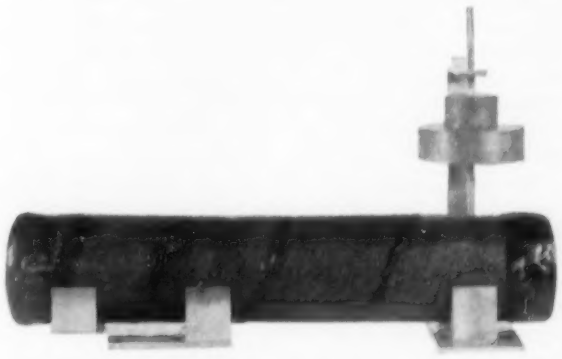


Fig. 4. Indentation testing apparatus.

In November 1955 Mr. Minton, whose company is an extruder of plastic pipe, was on a trip through California to contact various users of this type of product in the U. S. While in Los Angeles, he visited GAS' office. His purpose was to gather information on field experience of U. S. gas companies, which would later be conveyed to Canadian gas companies as yet inexperienced in the field of plastic pipe.

Smith & Stone Ltd. has carried out extensive work on the performance of plastic pipe at low temperatures. Since many locations in the United States have a range of temperatures similar to those of Canada, we feel that the work carried out by Smith & Stone will be of interest to many of our readers.

Tests predict performance of plastic pipe at low temperatures

By **J. W. MINTON** • Smith & Stone Ltd., Toronto, Ont., Canada

ABOUT a year ago our company undertook the manufacture of extruded plastic pipe. After careful investigation we chose Cellulose Acetate Butyrate (Tenite II) as the material for extrusion. Butyrate had been installed by a number of gas companies in the U. S. A. and information on field experience was available for pipe which had been in service for over 10 years. Also, a considerable amount of data were available on the physical properties of Butyrate and we knew that studies were being continued.

As we progressed, however, we found that certain information on the physical properties of pipe produced from Butyrate was scarce and we therefore decided to set up a program of testing the pipe which we were producing. Northern United States and Canada have an extremely wide range of temperatures and since all thermo-plastic pipe is affected by temperature change, the behavior of plastic pipe at low temperatures appeared to us to be a very vital factor in its successful application.

The material which we chose for our program was Cellulose Acetate Butyrate, Formula 435E black, supplied by Tennessee Eastman Corp. While most extruders in the U. S. use an "M H" flow material, we chose "M" flow material because of its improved impact resistance at low temperatures. Our testing program had as its objective the determination of the physical properties of 2-in. IPS plastic pipe produced from this raw material over a temperature range of 75°F to — 40°F.

Our early efforts to obtain low temperature test data using small dry ice chambers proved that it is difficult to obtain uniform temperatures throughout the sample and these early tests did not give reproducible results.

We were fortunate in securing the facilities of a research establishment which had insulated cold rooms capable of maintaining constant temperatures within 1°F. The entire test program at the low temperatures was conducted with these facilities.

The samples and testing equipment were all "cold soaked" at the testing temperatures and these facilities contributed a great deal to the accuracy and reproducibility of the test data.

Experience in the oil industry indicated that the majority of failures of plastic pipe installation occurred at the fittings. This clearly indicated the need to consider plastic couplings, adapters for plastic-to-metal, cementing and installation techniques in our program of investigation.

The following tests were conducted.

Impact testing

A study of available literature revealed various methods of testing the impact resistance of plastic pipe. The method which we chose was a free-falling weight or drop test. The test apparatus which was constructed was very simple.. It consisted of a 6-ft length of 2.125-in. ID metal pipe with a hole drilled 4 ft above the point of impact, a second pipe

of 2.0625-in. OD with a striking head welded to the bottom (this pipe was arranged to slide freely inside the first pipe), and a series of weights of various sizes, the smallest being ½ lb.

The inner pipe acted as a carrier for these weights which could be added in ½-lb increments. This carrier was drawn by cord and pulley to the 4-ft position inside the outer tube to a point where the striking head was 4 ft above the specimen. The striking mechanism was then secured by a pin. The striking head consisted of a ¾-in. rod welded at right angles to the metal pipe (see *Fig. 1*). The sample was supported on a flat metal surface and held in place by rubber bands.

The sample was struck by the falling weight, and the weight increased until failure was observed. The axis of the striking head was held at right angles to the pipe axis at impact. The results were expressed in foot-pounds (being the weight of the impact tube and weights by 4 ft of travel).

The results obtained were reproducible throughout the entire temperature range (see *Fig. 2*). The value in foot-pounds did not vary whether a series of six or eight impacts were carried out in increments before failure, or a weight close to the value necessary to obtain failure was used, and only two or three incremental increases obtained failure. The same foot-pounds-to-failure were obtained on 1-ft and 2-ft samples. It was therefore decided that 1-ft samples would be used for all testing. The test values did not change when the sample was rotated so that the point of impact was distributed around the pipe surface. The reproducibility of the results seemed important to us since these indicated that such a testing device, although simple and inexpensive, served the purpose.

Further test data on Butyrate pipe from other sources under different extrusion conditions indicate that the test is sensitive and can serve to distinguish variations in quality, at least from the standpoint of impact resistance. Field experience has shown that some failures have been due to brittleness of the pipe itself. This, of course, is more critical at the lower temperatures. Where pipe is likely to be handled at temperatures below freezing, impact quality must be carefully controlled. The simplicity and low cost of this type of impact equipment indicate that it might be a useful tool for the extruder and even for the large user of plastic pipe. It appears that once a curve is established over the temperature range it will be possible to establish impact specifications and maintain these through continuous testing of all production.

The difficult problem is to relate the values of impact resistance obtained by this or any test device to actual usage. This particular pipe has been handled in the field in a normal manner at temperatures below freezing.

Everyone who has had a part in the impact test program on this particular material has been impressed with the resiliency and strength of the pipe. It is almost impossible to break this 2-in. IPS Butyrate at room temperature with a hand hammer.

Burst test

The burst tests conducted on this material gave an average value of 650 psig at 70° F. Tests were conducted at the temperatures previously shown. The pipe samples were 1-ft in length and were fitted by means of plastic-to-metal adapters to a metal cap on one end and a reducing nipple connected to a hydraulic pump on the other end. Pressure at burst increased as the temperature was lowered. Maximum pressure at burst was reached at — 20°F. The average burst pressure at this temperature was 1100 psig. It is interesting to note that the adapters maintained a seal at the highest

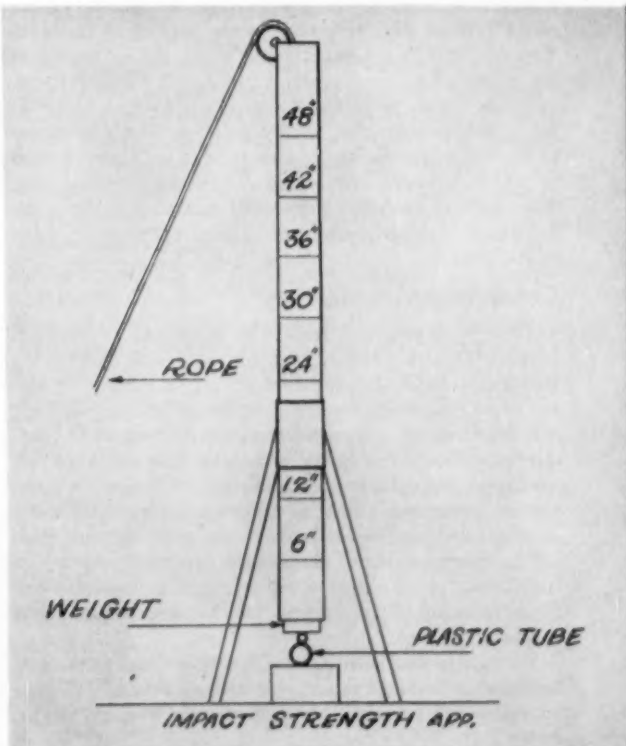


Fig. 1. Impact strength testing apparatus used by the author in testing this property of plastic pipe at low temperature. Note the simplicity of this inexpensive device. The results obtained were reproducible throughout the entire temperature range.

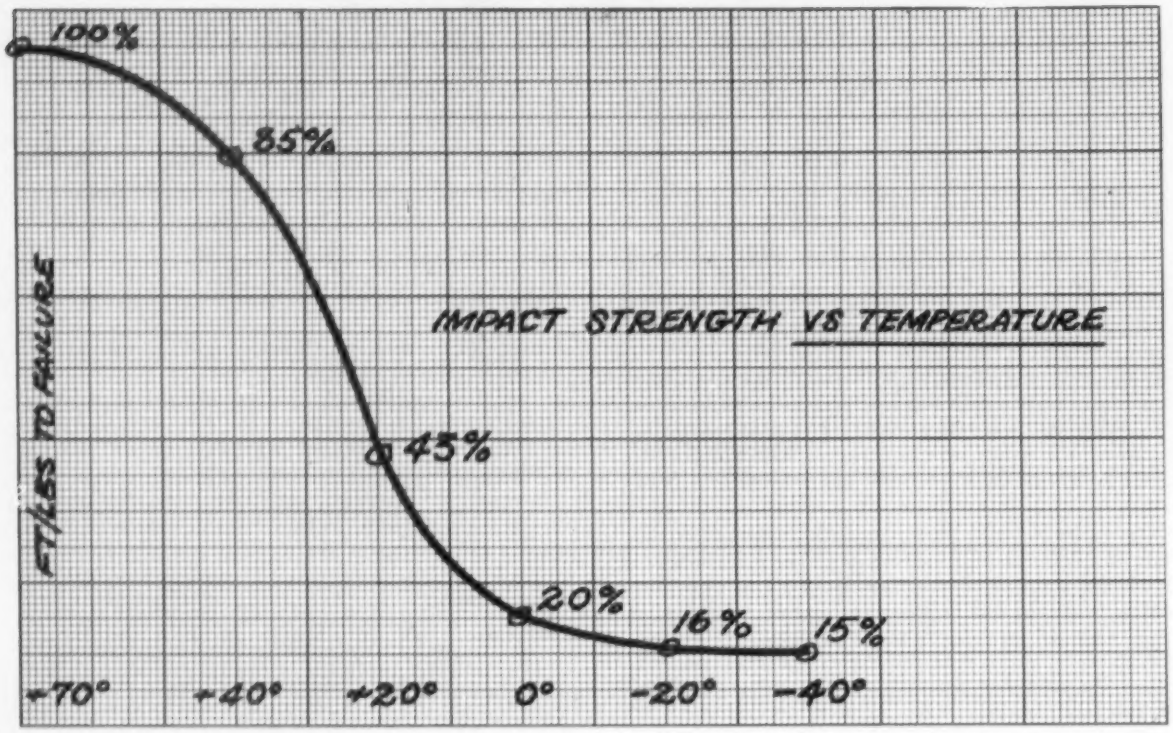


Fig. 2. Graph showing impact plotted against temperature. It indicates that impact quality must be carefully controlled when the temperature under which the pipe is used is below freezing.

pressure recorded during the test. Some of the samples increased in circumference by 2 in. to 3 in. before actual failure occurred.

This test was also conducted on samples of pipe with solvent-cemented, slip-sleeve couplings. The joints proved to be the strongest point with only a small percentage of failures occurring at the couplings.

Solvent cemented joints were made at —40°F with pipe, fittings and cement at these temperatures. It was necessary to cut back the cement with solvent by about 50%. Burst tests on the pipe cemented at these temperatures indicated no weakness at the joint.

Fittings

Molded slip-sleeve couplings from several sources were tested. Since a snug fit is essential for good joints, it is important that the fittings be dimensionally consistent. Some couplings which we received were too large on the ID and were rejected. Other couplings were brittle. Burst tests showed failures on these couplings at as low as 200 lb where the pipe would stand 600 psig on short-term burst. We have since insisted on fittings being molded from "M" flow Butyrate and we are testing all fittings by compression to 75% of their diameter.

Solvent-cemented joints made with good fittings are extremely durable, but, in general, fittings must be carefully checked as a potential weak spot in a plastic pipe installation. We have also found that the best joint is made when a generous amount of solvent and cement is used.

Metal-to-plastic adapters

In the gas industry, where pressures are in a low range, several types of adapters have been used with excellent results. Since our test activity was confined to 2-in. IPS Butyrate pipe it was necessary to find an adapter for plastic-to-metal that would be satisfactory for pressures as high as 1100 psig (at —20°) in order to conduct burst tests. The adapter used has a brass threaded ring which compresses a neoprene seal and is then imbedded on the outside surface of the pipe as the fitting cap reaches the end of its travel. This adapter has a metal stiffener which fits on the ID of the plastic pipe.

At the higher pressures obtained at 0°F to —40°F this fitting held pressure and resisted pull-out. It would appear to be well designed for connection of 2-in. plastic laterals to larger diameter iron mains. The brass threaded ring, when pressed to the pipe, is added insurance against pull-out either through pressure or thermal contraction of the plastic line.

Conclusions

The testing program which was carried out on 2-in. IPS Butyrate pipe provided a great deal of information on the low temperature characteristics of this material. It also served to established a pattern for future testing which we will be doing on other sizes and wall thicknesses of butyrate as well as other plastic materials. The results of this testing program clearly indicated that a considerable variation in impact and burst strength exists in pipe made under various extrusion conditions from the same raw material.

The future success of plastic pipe depends upon the accumulation of information on its physical behavior and the relationship of this information to service requirements and field experience.

We believe that such information is essential to the successful application of plastic pipe and we would be pleased to receive and exchange such information with anyone interested. ■

This report article brings you up-to-date on the use of plastics by a distribution company that started using the material in 1951. It relates the company's experience with plastic piping since it first reported on this subject to the gas industry in a 1952 issue of GAS.

A current report on plastic pipe in distribution company operations

By JOHN F. FUGAZZI, Distribution Maintenance Engineer
Public Service Co. of Colorado, Denver

BUTYRATE plastic tubing has continued to serve as a most satisfactory underground natural gas service pipe in the operations of the Public Service Co. of Colorado. We have not experienced any failures of the material. In fact, the aggregate total of all of the failures we have experienced to date, which are chargeable to all other causes, have been insignificant in number.

Since our first plastic tubing experience report* we have continued to use plastic tubing for new, uncased gas service pipe. In 1954, we adopted the use of the material for the replacement of steel service lines by the insertion method. We have not used or experimented with any kind of plastic for gas main pipe.

Our first plastic tubing gas service line was laid in March 1951. Since that time, we have installed approximately 3800 new plastic gas service lines. Approximately 1100 plastic insertion gas services have been installed since the replacement practice was effected early in 1954. The aggregate lineal footage of plastic tubing in use in our natural gas distribution system exceeds 325,000 ft.

We currently specify Tenite II, Formulation #435, Flow M.H., transparent plastic tubing; 1.055 in. OD, 0.870 in. ID; packaged in a 6-ft diameter, 250-ft coiled length bundle. We use only the one size pipe. Coiled tubing has proved to be very practical for both new and replacement service pipe.

We have continued to use Tenite II in preference to other kinds of plastic tubing because we know more about its qualifications as a pipe material. It is the material that we initially selected for experimentation and use. Since its service record in our operations has been excellent, we have been reluctant to use other kinds of plastic tubing until either we have time for further experimentation, or the qualifications of other plastic materials for such end use have been proved by other parties. We wish to emphasize, however, that there may be other kinds of plastic tubing currently available that are as good or better than Butyrate for natural gas distribution pipe.

Plastic tubing is used by our company for new, uncased service pipe on a limited and selective basis. We use it in new gas distribution areas wherein corrosive soil conditions are expected to be most severe. By such a practice, we not only perpetuate our plastic tubing experimentation program but also use the material in areas where the greatest potential benefits may be realized as a result of its corrosion resistant property. There is good reason to believe that the service life expectancy of plastic tubing in corrosive soils

*See "Plastic Tubing Use Found Practical at Public Service Co. of Colorado," *GAS*, October 1952.

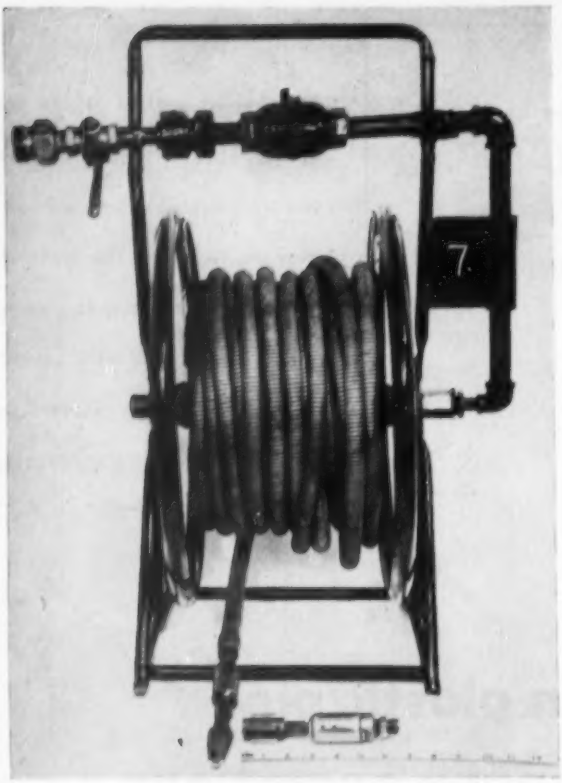


Fig. 1. Apparatus used by Public Service Co. of Colorado to ream and blow old metallic service lines prior to inserting plastic pipe.

will be as good or better than that of steel pipe subjected to like soil conditions. How the service life of the two pipe materials will compare over a long period of time when they are subjected to relatively non-corrosive soil conditions is still unknown. The total cost of new gas service line construction cannot be reduced appreciably by the use of plastic rather than steel pipe.

Early in 1954, the use of plastic tubing for the replacement of existent steel gas services by the insertion of the plastic through the old steel pipe was adopted by our company as a preferred method of service pipe renewal. It is a practice that we observe whenever operating conditions permit. Since the practice was effected, 85% of our gas service replacement work has been performed by the new method.

The plastic insertion service replacement method has enabled us to obtain immediate and noteworthy benefits. We have been able to reduce replacement costs by more than half and to more than double work volume production per crew. Prior to the use of the new method, we replaced an old service by the underground installation of a completely new steel service. Such service replacements required at least a crew day to complete. The decrease in service replacement crew time has been especially beneficial to us. It has helped us to keep abreast of necessary maintenance work and at the same time handle a phenomenal gas distribution system growth.

Customer relations is of vital concern to every company. The new method eliminates in many cases a common cause of customer complaint: the major excavations in a customer's landscaped property heretofore required. The customer is never happy to hear that excavations have to be made in his lawn to replace a pipeline, no matter how important it is that the work be done. Customer good will is protected and perpetuated by the insertion method of pipe replacement.

The installation of plastic tubing directly in the earth or inside of an old pipeline and its connections to metal piping are rather simple operations. Since the details of our standard installation practices for new service construction were related in the first report, I will discuss briefly only our insertion installation procedures and practices.

After exposure and disconnection of the old service line at the gas main and at the building, the steel pipe is thoroughly reamed and "blown" to remove all sharp metal surfaces, welding icicles, etc. on the inside wall of the pipe, and to remove all foreign matter deposits. In the majority of installations, not more than one small excavation is required in the customer's property, and that one, if necessary, at the building wall. If the old service is an underground, front wall entry installation, no property excavations are required except when meter relocations are necessary. After the steel pipe has been cleaned, a continuous length of plastic tubing is pushed through the steel pipe and cut to the desired length. A steel insert sleeve and a metal compression coupling are used to connect the plastic tubing to a steel nipple outlet from the gas main pipe. The building end of the plastic tubing is either connected to metal piping underground and outside of the building by the use of like fittings, or it is extended inside of the old underground pipe to the inside face of the basement wall where it is terminated inside of metal pipe and fittings. A special service-head adaptor fitting is used in the latter installation. The metal adaptor fitting has 1¼-in. internal and 2-in. external threads at one end, and a ¾-in. compression outlet at the other end. It is turned on to the old steel pipe at the point of service entrance in the building basement. The plastic tubing is extended through the adaptor and terminated approximately ½ in. outside of the fitting. It is connected to the same fitting by the insertion of a steel stiffener sleeve in the plastic and the tightening of the compression nut on the fitting. A 2-in. steel tee, plugged at one end, is then turned on to the adaptor fitting to completely enclose the open end of the plastic tubing and to provide a metal fitting for the steel piping to the meter location.

Steel insert sleeves are always used in conjunction with compression-type fittings to support the plastic at the points of compression. All of the metal compression-type fittings we use are equipped with armor tipped compression gaskets. The armor tip gasket provides additional insurance against "pullout."

Fig. 1 illustrates the equipment used to ream and blow an old service line. An air compressor is required, of course, to power the reamer motor and to blow the service. A rubber air hose is encased by the flexible steel tubing. The flexible tubing provides rigidity for reaming and, also, the flexibility required for reel operation.

Only a few weeks were required to thoroughly train our construction crews in the new replacement practice without serious impairment of construction progress. Engineering personnel trained a number of selected men to act as in-

structors. They, in turn, trained construction crew personnel. The training course consisted of classroom discussion and field installation demonstrations.

In the fall of 1952, a simulated plastic insert service was installed in our warehouse yard to determine the approximate amount of contraction tension that would be developed in the plastic line as a result of temperature drop during the winter season, and to determine the effectiveness of plastic-to-steel compression-coupled connections when subjected to such a tension force. Field conditions were simulated by the installation of 100 lineal ft of steel cased plastic tubing in the earth at a depth of 18 ins. The plastic was not cased at each end to allow for assembly to metal fittings. The plastic tubing was connected to steel nipples at each end with metal stiffener sleeves and compression couplings equipped with armor-tipped gaskets. The steel nipple at one end was welded to a rigidly anchored metal structure. The steel nipple at the other end was anchored to a 200-lb weight scale, which, in turn, was securely connected to a metal structure rigidly anchored in the earth. A wooden manhole was built in the earth at the one end of the installation to enclose the open end of the casing, the exposed plastic tubing, the fittings and the scale. The element of a temperature recorder was placed in the earth at the level of the buried casing. After final connection, the plastic tubing and steel nipples were permanently marked for position with relation to the couplings. The complete installation was earth covered.

Daily readings of the scale and earth temperature recorder were taken and recorded. During the winter season, a maximum plastic contraction tension of 68 lb. was recorded as a result of an earth temperature differential of 54° F. The coupling assembly in the manhole was inspected daily for movement of either the plastic tubing or the fitting. The coupled connection at the other end was exposed when inspection was desired.

The tension force developed in the tubing did not pull the plastic tubing out of the couplings, nor did it pull the couplings from the steel nipples. In fact, no measurable movement was noted at the coupled connection at either end of the installation. A similar test was conducted the following year with equally encouraging results.

The field installation tests together with shop tests conducted to determine the effectiveness of our plastic-to-steel connections indicate that we should not experience any troubles from pipe pull-out, a more likely source of trouble, in plastic insert installations. Inspection of a number of active relatively old, plastic insert service lines last winter did not disclose any evidence to the contrary.

We are quite satisfied with the performance of Butyrate plastic tubing. There is every reason to believe at this time that the material is fully acceptable for use as a natural gas distribution pipe, if adequate precautionary assembly and installation practices are observed. The service life of the material is still an unknown factor. Its years of service to date, however, are quite impressive. ■

John Fugazzi, a native of Colorado, has been with Public Service Co. for 15 years. During most of that time he has been engaged in the mitigation of underground pipe corrosion. Currently he is chairman of the AGA subcommittee on plastic pipe standards and also chairman of the Rocky Mountain section of the National Association of Corrosion Engineers.

Plastic tubing installation instructions service replacements

Instructions pertaining to the use, assembly and installation of continuous coil plastic tubing for gas service pipe replacement by the insertion method.

1. Plastic tubing (¾-in. nominal, 1.055-in. OD, 0.870-in. ID in continuous coils) may be used in the majority of cases in low pressure systems to replace 1¼-in. gas service piping.

Usually, the gas service renewal order will specify the size and kind of pipe which shall be used to replace the old service pipe. In other cases, the gas-service-locator man shall be contacted for on-the-job determination of size and kind of pipe.

2. All plastic tubing shall be inspected for faults due to mishandling or manufacture before the material is used. Tubing shall not be used if there are cuts, deep scratches or imperfections such as bubbles or foreign matter in the material. Imperfect tubing shall be tagged, the fault described thereon, and returned to the Denver stores department for inspection by the gas distribution maintenance division.

3. Plastic tubing shall never be used for aboveground or building piping except in plastic insertion cases wherein the tubing will be completely enclosed by metal pipe and fittings. When not so enclosed, the tubing shall always be terminated below the ground level and outside of the building wall in the horizontal run of the service. See standard construction sketches for approved installation practices.

4. Plastic tubing shall be connected to steel pipe by the use of a compression coupling with a metal stiffener sleeve placed inside of the plastic and centered under the coupling gasket. The malleable nut-type compression coupling shall be used and well tightened to avoid future pull-out of the service pipe due to contraction of the plastic during the winter season.

5. Exposed plastic tubing shall always be laid on level, undisturbed earth or properly supported by a well compacted backfill beneath the tubing.

6. In all cases of steel pipe replacement in rocky soil by the insertion of

plastic tubing, any exposed (uncased) sections of the plastic tubing shall be properly protected against damage by a well compacted earth backfill support and a cover of 12 in. of unabrasive soil or by the installation of a short section of a larger size steel pipe over the exposed plastic.

7. Plastic tubing shall never be inserted into an old steel service line until the steel pipe has been thoroughly cleaned and reamed, as follows:

7-a. Disconnect the old service pipe at the gas main and at the service terminal. Cut and remove a short section of the steel pipe at the main and at other desired points (see construction sketches).

7-b. Purge the old service pipe by the introduction of compressed air at the building end of the service so that all foreign material in the pipe will be blown out of the pipe into the street excavation. Compressed air shall be admitted by partially opening the air valve at the beginning of the purge to avoid possible plugging of the pipe with foreign material.

7-c. Hand ream all of the open ends of the steel pipe thoroughly to remove all sharp metal edges.

7-d. Connect the reamer air hose to the compressor with the reamer and air motor detached and release air through the hose until sufficient oil to lubricate the air motor is being carried to the outlet end of the air hose.

7-e. Attach air motor and expanding-type blade reamer to the air hose; insert the reamer head into the steel pipe at the building end of the old service; open the air valve and commence the cleaning and reaming operation. To prevent accidents, never open the air valve until the reamer is in the pipe. Where the reaming operation must be conducted from the street end of an old service pipe which terminates inside of a building, a rubber hose or other suitable equipment shall be attached to the building end of the steel pipe and extended through a window or door opening to vent the waste air and dirt to the outdoors.

7-f. Ream the steel pipe throughly by pushing the revolving reamer through the entire length of steel pipe with the steel encased air hose. The rate of reamer travel will depend on the interior condition of the pipe. Where the pipe is relatively clean, the reamer can be steadily pushed through the pipe. Obstructions such as sharp steel edges left by a pipe cutter and foreign material deposits can be felt by the reamer operator and when so detected the reamer shall be worked back and forth through the obstruction to insure a good reaming job.

7-g. After the pipe has been thoroughly reamed, it shall be blown clean by the introduction of compressed air at the building end.

7-h. In cases where the expanding-type reamer will not pass through a partial closure, the non-expanding tapered reamer can be used. In such cases, the pipe shall always be reamed afterwards with the expanding reamer.

7-i. In terraced installations, wherein the old steel pipe is laid at different elevations with a riser connection, the pipe riser and fittings may be exposed and removed. The two sections of such a service can be individually reamed. The plastic tubing will, in most cases, during insertion conform to the change in elevation without difficulty. If not, a few feet of the horizontal run of the old steel pipe at the riser location shall be removed to allow the plastic to be inserted without strain into the other section of pipe.

7-j. In most cases, the expanding reamer blades will be too dull for use on a second service line. If blades must be changed in the field, the flat side of the blades shall be installed to face the clockwise movement of the reamer. Removed blades shall be returned to the shop for re-sharpening.

8. Procedure and instructions for the insertion of plastic tubing through a cleaned and reamed steel pipe.

8-a. The leading end of the plastic tubing shall be closed either by the use of a tapered wooden plug or by heating a few inches of the tubing and shaping it by hand to a closed tapered point to aid in slipping the plastic through couplings in the steel line.

8-b. Insert the plastic pipe through the steel pipe. The plastic shall be guided and pushed through the steel pipe by a man in the trench. The continuous coil of tubing shall be revolved in a vertical position to uncoil as it is delivered to him.

8-c. After the tubing has been inserted, it may be cut to length with a hacksaw with the leading end cut to remove any damaged material. If the tubing may have been damaged during insertion, it should be pushed sufficiently through before it is cut that a reasonable amount of the leading end can be inspected. Any plastic that has been cut or scratched deeply shall not be used.

8-d. After the tubing has been cut to length, special rubber gasket separators shall be cut diagonally, placed over the plastic tubing, and tucked inside of the steel pipe at all of the exposed ends of the steel casing pipe.

8-e. The plastic tubing shall then be assembled with the steel pipe and/or fittings to be used to complete the gas service line in conformance with standard plastic tubing service construction sketches.

e-1. To prevent twisting of the plastic tubing, service head adaptor fittings and compression couplings at the house end of the service shall be installed before the plastic tubing is connected to steel pipe at the gas main; also, the compression coupling which is used to make the final connection at the gas main shall be assembled by tightening first the plastic side of the coupling with the backup wrench applied to the barrel of the coupling and then by tightening the other side of the coupling with the backup wrench again applied to the coupling barrel.

9. All plastic gas services shall be air tested at 15 psi in the same manner as steel services.

10. All underground steel fittings and pipe connected to plastic tubing shall be wrapped with pipe coating tape with the coating overlapping a few inches of the plastic tubing. The plastic tubing will burn and support combustion, so care should be exercised in the handling of open flame torches. Whereever possible, hot applied coatings shall be applied to plastic-to-steel joints before the release of natural gas into the service line.

11. Active, exposed plastic service pipe shall not at any time be left exposed in an open trench during the absence of installation crews but shall be covered with earth to protect the tubing from accidental fire or physical damage.

12. Plastic services shall be identified by a metal band placed over the metal service pipe. On outside meter sets, the metal band shall be placed above ground adjacent to the service valve. On inside sets, the band shall be placed inside of the building adjacent to the service valve. The words "PL Tubing" shall be stamped into the metal band. ■

Plastic piping up in 1955

GAS staff report

Plastic piping still is a leading discussion topic in the gas industry. This report brings you up to date on what men in the industry were saying about this subject in 1955.

SOME gas distribution companies like plastic pipe, some do not. But, the interest in the developments of this material and the experimentation to establish its advantages as a piping are gaining ground more rapidly than ever before. Operational-type usage is up, experimental usage is up, and the required experience to establish plastic piping as a standard component in distribution systems is being gathered.

GAS surveyed most of the companies in the industry to augment and extend a similar investigation of plastic pipe usage reported in the March 1955 issue. The purposes of the current study were to determine the extent of distribution work being done with plastic piping during 1955 and get the trend for 1956.

In the 1955 report—covering experience through Dec. 31, 1954—there was indication of acceleration in plastic pipe usage. During 1955, the acceleration continued as more and more distribution operators initiated programs to evaluate its application.

The survey of the plastic pipe activities in the gas industry revealed that 40 distribution companies had installed plastic piping to Dec. 31, 1954. The applications these users have made of the material have been classified by our staff merely for statistical and interpretive purposes, as follows:

(1) *Experimental users* — Those companies who have installed up to 1500 ft of plastic pipe in actual distribution operations during 1955.

(2) *Development users* — Those companies that installed more than 4000 ft of plastic pipe in their distribution systems during 1955. Some of these companies are actually doing large scale experimentation while others consider plastic piping for specific, limited applications as operational.

Twenty-nine companies installed plastics during 1955. Ten of the 29 companies indicated they would increase the installation rate of plastic pipe in 1956; one said it would discontinue the installations; two companies said they would continue to install plastic pipe during 1956, but would decrease the rate; 10 replied they would install about the same footage in 1956 as they did in 1955; and six companies plan to delay any further installation until they can evaluate their current programs and/or take advantage of further improvements in the plastic products themselves. Thirteen of these 29 companies we have listed as making application of plastic pipe during 1955 are classed as development users, while 16 are classed as experimental users.

The development users are shown on *Table 1*. Of these 13 companies, six plan to increase the installation rate of plastic pipe footage in 1956; three will install about the same footage in 1956 as was done in 1955; one will discontinue this material for a particular application, but will continue with other applications on about the same scope as in 1955; and three are undecided or will await further experience and developments.

In answer to the survey question, "Do you consider plastic piping successful from an operating point of view?" . . . nine answered "yes." It should be understood, however, that some of these "yes" reactions are based on experience to date and should be considered tempered by limitations of time and application experience.

Other answers to this question by the development users were: "Inserts very satisfactory—new services very susceptible to damage by yard work, particularly in the light wall thickness."

"The pipe has been satisfactory—however, the adapters to steel pipe have been unsatisfactory." This company's usage in 1956 depends on finding a suitable adapter.

"With only three years of experience, in our opinion it is premature to judge successful operating experience with this material. No unexpected difficulties have resulted to date."

Those companies that we classified as experimental users are shown on *Table 2*. Four of these companies will increase their installation rate of plastic pipe in 1956; seven indicate that they will use about the same footage as they did in 1955; three will hold off to wait for developments in plastic pipe production and application; one will decrease its installation rate in 1956; and one company will discontinue its application.

In answer to the same question concerning the success of these installations from an operating point of view, eight companies answered "yes." The following are some of the comments from those answering in the affirmative:

—"Yes, so far we have found it a reasonable material for our particular use."

—"Yes, we have found it to be very successful."

—"Yes—particularly service replacements."

—"Successful as far as our limited experience indicates."

Other comments resulting from this question were:

—"Not enough experience to make a statement."

—"Not in our system at the present time. We have had trouble with our experimental plastic services following

periods of peak shaving activity, when oil gas was distributed. Softening of the services due to the entrained aromatics caused failure."

—"At the present time we do not intend to use this pipe underground because for peak shaving it is necessary for us to produce substitute gases. The properties of the condensates from these substitute gases do not, in our judgment, allow for the use of plastics."

—"No—application limited at present—some very good applications in narrow limits."

—"Not for our purpose due to occasional manufacturing."

Previous users who didn't install plastic pipe in '55

The survey indicated that 11 companies who installed plastic material piping before 1955 did not have any activity in this field during 1955. Three of these 11 companies stated that they would start plastic piping installations again in 1956 and indicated that they would increase the installation rate. One company said it would discontinue installing plastics because—"Too easily pulled loose from fittings . . . sags causing trapping of condensate." Another company that has no plans for additional usage feels that "Mitered fittings used were unsatisfactory. No other major deficiencies noted up to the present time." A utility located in Wisconsin reports that it is undecided on the matter of using more plastic piping but "So far it has been successful."

GAS' survey turned up 19 distribution companies that have never used plastic piping in the past, but will install some for the first time in 1956. Most of these will be on a relatively small scale, but will certainly be classed as experimental users. The increase-for-the-year value (19 companies) can be compared with the total users (for all years) as reported in the survey—40 companies.

Survey shows interest is high

Interest in plastic piping developments ran high in 1955 and will increase in 1956. Seventeen companies (additional to any mentioned previously) responded to the effect that they were denitely interested in plastic piping for future distribution work, but will wait to see the results other companies experience. Most of these companies have either given the matter some research or are currently working on relative studies. Some of their comments are:

—"Interested in plastic pipe, perhaps will experiment."

—"May use when natural gas is available."

—"We do not plan too much use of plastic pipe until

TABLE 1. DEVELOPMENT USERS OF PLASTIC PIPE

Company	Installed in 1955				Size		Max. Press., Psig	Description of Plastic Piping Used
	Services		Mains					
	New, Ft	Insert, Ft	New, Ft	Insert, Ft	OD,In.	Wall Thickness, In.		
Arizona Public Service Co., Phoenix	20,000	30,000	—	—	0.625	0.050	15 to 30	Kralastic, Tenite II, Butyrate
Arkansas Louisiana Gas Co., Shreveport	100	—	5,200	—	2.375	0.125	25	Busada Series 200, Acetate Butyrate
Gas Service Co., Kansas City, Mo.	—	10,000	—	—	1.140	0.140	25	Yardley C/P, Butyrate
Lone Star Gas Co., Dallas, Texas	—	15,000	—	—	1.140	0.070	30	SWP clear Tenite semi-rigid tubing
Louisville (Ky.) Gas & Electric Co.	4,200	—	—	—	1.420	0.085	20	Continental Can Co. Mills II, Butyrate
Milwaukee (Wis.) Gas Light Co.	—	4,290	—	1,732	1.125 2.250 3.250	0.053 0.125 0.125	2	Continental Can, Anesite Co., Butyrate
New Orleans (La.) Public Service	1,800	—	3,064	—	1.050 1.090 2.375	0.090 0.090 0.125	60	Semi-rigid Kralastic, Styrene
Pacific Gas & Electric, San Francisco	27,250	—	—	—	1.050	0.090	50	Tenite II, #435-MH-clear, Cellulose Acetate Butyrate
Peoples Gas Light & Coke, Chicago	—	228,157	—	—	1.375	0.053	6 in. w.c.	Tenite II, Cellulose Acetate Butyrate, Perfex #2055, Anesite #408 clear
Public Service Co. of Colo., Denver	90,000	45,000	—	—	1.050	0.090	15	Tenite II, #435-MH-clear, Cellulose Acetate Butyrate
Pueblo (Colo.) Gas & Fuel Co.	—	4,000	—	—	1.050	0.100	10 to 120 in. low pressure	Tenite II, #268-MH-clear, Cellulose Acetate Butyrate
Tucson (Ariz.) Gas Elec. Light & Power	2,000	3,000	—	1,000	0.840 1.050 2.375 4.500	0.090 0.090 0.090 0.155	60	Kralastic, modified styrene
United Gas Co., Houston	2,267	—	2,794	—	1.500 2.000	—	50	Kralastic, high-impact styrene
TOTAL	**147,617**	**339,447**	**11,058**	**2,732**				

TABLE 2. EXPERIMENTAL USERS OF PLASTIC PIPE

Company	Installed in 1955: Services, New, Ft	Services, Insert, Ft	Mains, New, Ft	Mains, Insert, Ft	Size: OD, In.	Size: Wall Thickness, In.	Max. Press., Psig	Description of Plastic Piping Used
Battle Creek (Mich.) Gas Co.	—	750	—	—	1.125	0.062	30	#308 Anesite
Central Electric & Gas, Lincoln, Neb.	450	550	—	—	1.050	0.090	10	Tenite II, #435-MH, Cellulose Acetate Butyrate
City Utilities of Springfield, Mo.	—	1,126	—	—	1.125	0.062	—	Kraloy Tenite II
Equitable Gas Co., Pittsburgh	—	220	—	—	3.000	—	30	Green fiber cast pipe
Gas Light Co., Columbus, Ga.	500	700	—	—	0.855	0.053	50	Continental Can, Mills Butyrate III
Laclede Gas Co., St. Louis	—	—	—	—	1.125	0.053	45	Tenite II, Acetate Butyrate
Long Island Lighting Co., Mineola, N. Y.	—	—	—	500	2.375	0.154	8 in. w.c.	Tenite II, Busado 210, Cellulose Acetate Butyrate
Mississippi Valley Gas, Jackson, Miss.	430	241	—	426	0.855 1.05 1.73 2.25	0.053 0.075 0.115 0.125	50	Tenite II, #435E-22300-MH, Cellulose Acetate Butyrate
Northern Indiana Public, Hammond	—	1,000	—	—	1.161	0.053	15	Tenite II
Peoples Natural Gas Co., Pittsburgh*	—	—	—	—	—	—	—	Van-Cor #2, Tenite II, Kralastic
Pioneer Natural Gas, Amarillo, Texas	—	30	—	—	—	—	50	Tex-Trude
Rio Grande Valley Gas, Brownsville, Texas	—	400	—	—	0.750	—	—	Kralastic
San Diego (Calif.) Gas & Electric	—	—	501	—	0.625	0.062	60	Kraloy Tenite II
Southeastern Michigan Gas, Port Huron	638	648	—	—	1.050 0.625 1.125	0.113 0.60 0.062	40	Mueller Brass Polyethylene, Carlon G/F Polystyrene
Washington (D. C.) Gas Light Co.	250	250	—	—	0.625 1.050	0.062 0.110	30	Tenite II, Kralastic
West Tennessee Gas Co., Jackson	500	—	—	—	1.315	0.133	20-25	Republic Steel Type FE
TOTAL	**2,768**	**5,695**	**721**	**926**				

* 300 ft for educational and experimental purposes.

its resistance to oil gas is substantial, or we get into the position of not having to peak shave."

—"We are interested, but only on an experimental basis for the present."

—"I am interested to hear from the results of this survey."

—"Have never used any plastic, but am interested."

—". . . We in all probability will not institute the use of plastic pipe until further studies and tests have been made with definite conclusions and specifications standards so that plastic piping will be approved by nationally recognized agencies." *(Several companies indicated they would hold up on applications until the ASA B31.1.8-1955 Code approved the use of this material for piping—Ed.)*

—"Not at this time. Improvement of product could make a big difference."

—"Await development of suitable product."

Two companies not involved with any of the previous statistics indicated concern over the effects of the extreme weather (low temperature) conditions in their operating areas in relation to plastic pipe service. Many reported deep concern when plastic piping was used with manufactured gases, but see some future applications within their distribution systems when and if they can depend on 100% natural gas service.

So, there you have what men in your industry were saying about plastic pipe up to Jan. 1, 1956. In summation, 40 companies are now using it and 29 of these made installations in 1955; 19 will start installations for the first time in 1956; 17 companies are waiting to see others' experience before making actual installations; and 121 reported either no plans or no opinions relative to plastic pipe.

The most significant concept to be gained, however, is that 500,000 ft of plastic piping was installed in 1955 (by reporting companies) as compared with 800,000 ft for all years prior to that year. This means that as more experience is gained, the usage has increased. Is this a trend that will lead to major acceptance in the near future? We would like to have your opinion. ■

Natural gas and plastic pipe team up to take over irrigation load in West Texas

By RUEL McDANIEL

DOWN in sprawling Texas, farmers in the Lubbock area have been organizing partnerships, corporations, and a variety of other grouping entities for the past two years with the objective of installing their own "group lines" that tap fast-moving Pioneer Natural Gas Co.'s feeder lines to bring natural gas to engines driving irrigation pumps. Metallic pipe has been used in some instances, but plastic piping has been installed too and seems to offer the farmer groups many advantages. This latter activity has just resulted in the announcement of an order for 150 miles of 2-in. ID plastic pipe to be used for this service. It is felt that the utilization of such pipe in irrigation is just beginning to take form.

The 150 miles of Republic SRK Kralastic pipe specified for transmission of natural gas will be layed near Nazareth, Texas, with 24 to 30 in. of cover. The 2-in. ID dull-black pipe will be supplied in 30-ft lengths with a coupling provided at one end. Lengths will be jointed with a welding liquid applied between the coupling on one length and the plain end on another. The pipe is semi-rigid, which adds to its easy installation characteristics.

Behind this program is an interesting story of cooperation between the farmers in the High Plains country and Pioneer Natural. It is a story that highlights load building at its best in the gas industry and free enterprise at its best in the national economy.

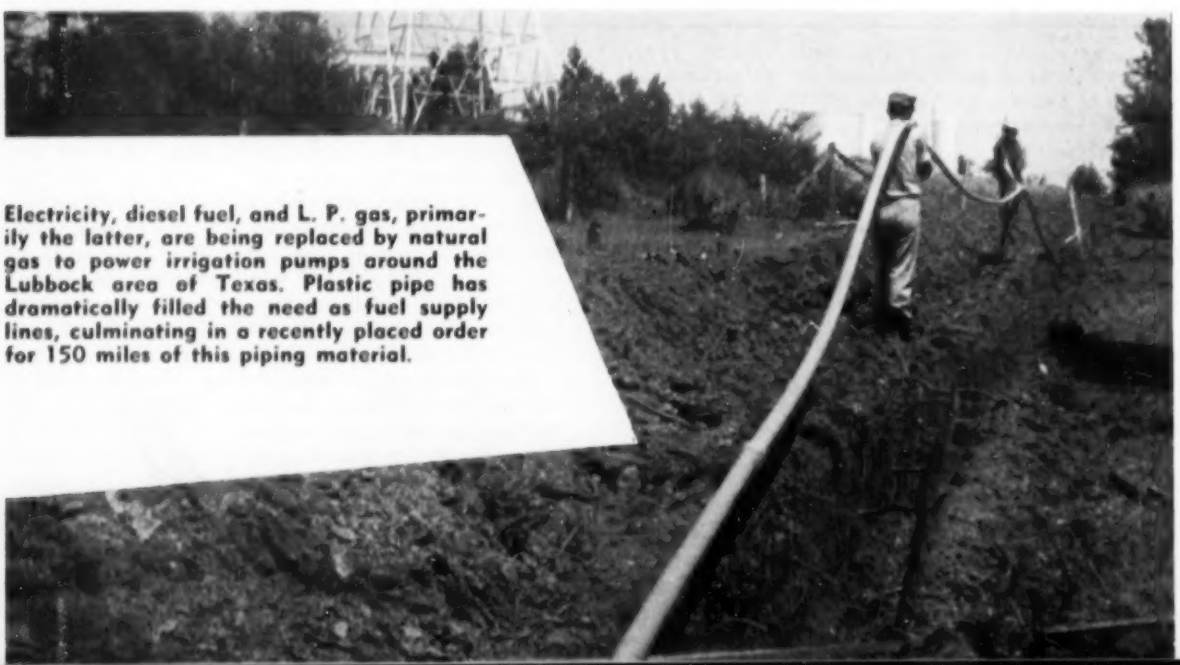
Last summer the West Texas division of Pioneer Natural Gas Co., with main office in Amarillo and West Texas division office in Lubbock, had completed an expansion program started early in 1954 which saw 794 miles of new line laid and service extended to about 5000 new customers and 8000 irrigation wells.

Of this program, 276 miles were built in the period 1952-54 and the remainder — 518 miles — completed by the end of August 1955. Last year's construction cost about $5.8 million, according to R. M. Curry, division manager.

But this expansion program was more than just an ordinary expansion. It was a culmination of a sort of "revolution" in the concept of the natural gas market in the South Plains area of Texas. It was the result of the discovery of the irrigation industry as a tremendous potential market for natural gas.

As a result of this discovery and the ultimate expansion program, Pioneer's normal off-season has been turned into a peak season. Today, the company's volume is greater in summer than in winter, mainly as a result of extending service to irrigation farmers.

For some time Pioneer had been serving a comparatively few irrigated farms from its regular lines, and the company was aware, to a degree, of the potentialities of irrigation. Yet the maximum average number of irrigation wells that could be serviced from a line made it impractical, in most cases, to utilize the investment necessary to serve most irrigation wells from regular



Electricity, diesel fuel, and L. P. gas, primarily the latter, are being replaced by natural gas to power irrigation pumps around the Lubbock area of Texas. Plastic pipe has dramatically filled the need as fuel supply lines, culminating in a recently placed order for 150 miles of this piping material.

transmission lines hence the need for cooperation.

Then farmers who had talked to their acquaintances who had been using natural gas began to drop in and talk to Mr. Curry about the possibility of their obtaining natural gas.

"My neighbor pumped twice as much water this past season as I did," one farm said, "and yet his fuel bill was only about the same as mine. He used natural gas."

A couple of farmers came in and asked if there wasn't some way they could build their own gas line and tie onto the company line and obtain gas for their 15 well pumps.

From these conversations with farmers and on the basis of the volume of gas being sold to the comparatively few farmers within reach of company lines, there gradually evolved a mutually tenable plan. The company's share in this plan was the more-than-five-million-dollar construction program just completed.

For every mile of new feeder line the company built, farmer groups have built several miles of distribution lines that tie on to new company lines.

In the High Plains country, the normal slope of the land is from northwest to southeast, and this means that many wells are located in the northwest corners of the tracts of land being irrigated. This situation was important in planning service to farmers, for theoretically the lay of the land presented a perfect pattern for laying out group lines extending from a base line. Lakes, marshes, and draws precluded a perfect pattern and the plot for new lines.

However, in general the expansion proposed to lay a feeder line at intervals of about eight miles, thus placing the farthest potential consumer no more than four miles from a company line.

After Pioneer announced its plan for extending services to certain irrigation areas, there was little selling to be done on the part of the company. Farmers got together in small groups, talked over the potential use of gas for their irrigation pumps and for their domestic use and formed corporations, trusts, or informal groups, or otherwise banded themselves together to build their own distribution lines from the company's proposed feeder network.

It wasn't long before the wildfire of enthusiasm spread throughout the West Texas Division. Forty-five new irrigation laterals were put in during 1955, and by last September the company had 5506 irrigation accounts representing approximately 9500 irrigation wells. That's more than one irrigation account per 20 customers, since the West Texas division serves about 100,000 meters.

Much more significant, however, is the size of the load in terms of gas usage. In the short space of three years, Pioneer Natural finds itself with a new major load. In 1952, when irrigation was not being actively pushed, irrigation sales aggregated only 930,400 Mcf as against a total annual sendout of 22,100,081 Mcf. In 1953 it began to hit its stride, accounting for an annual sendout of 2,126,326 Mcf as against a grand total of 22,597,810 Mcf. In 1954 the load had grown to 6,269,776 Mcf, nearly one quarter of the aggregate of all sales for the year.

By last summer, the hot weather peak day had passed the winter peak. Highest demand for gas at the crest of the irrigation season was 152,844 Mcf. Winter peak in 1954-55 was 131,543 Mcf.

July, August, and September are the big months for this load. It is then that the growing season is at its height, and seasonal rainfall is normally inadequate to produce a crop yield such as the farmers have come to expect with irrigation. April and May are also heavy pumping months, with preplanting work at its peak. From October through March there is little pumping activity, as is the case in June, and October and June are ordinarily the minimum sendout months.

In planning feeder lines, the company considered not only the land already under irrigation but the additional land that might be brought under irrigation, once cheap fuel was made available to dry-land farmers.

Many factors enter into the extensive cost of irrigation, and one of the major factors is fuel. The company was certain, after its surveys, that a substantial saving in fuel cost would be the determining factor in persuading many farmers to switch to irrigation. Fuels that natural gas replaced were electricity, diesel fuel, and L. P. gas—primarily the last named. In most cases, conversion was made by firms that serviced the LPG or other engines.

The company's own expansion program operated hand-in-hand with the activity of farmers in organizing and providing for their own lines to tap onto Pioneer's irrigation feeder lines. With few exceptions, there was sufficient potential utilization to justify construction of the feeder line before work started.

The group line, as the farmer-owned installations are called by Pioneer, came into being as the company figured its own amortization potential on proposed feeder lines.

"It was agreed," Mr. Curry says, "that if a company line was a reasonably attractive long-term investment, a common line constructed at the consumer's cost in areas where the water-lift factor and spacing of wells was favorable would pay for itself in fuel savings in five years or less and would be, there-

fore, an attractive investment for the potential consumer."

In making a final decision as to the soundness of the company's building an irrigation feeder line and of the farmers' proposed investment, the company considered whether or not the proposed area was irrigated from shallow wells or deep wells. Shallow wells as defined in the High Plains area, are those of 100-ft depth or less; deep wells run from more than 100 ft to as deep as 400 ft. The deeper wells have a longer potential life and thus make an investment in fuel lines more attractive.

The group line actually was rendered workable by an agreement between Pioneer and the several proposed owner-members of the group line. The agreement covers these points:

1. The group constructs a line, or lines as necessary, at its own expense, under specifications approved by Pioneer, for distribution of gas to their individual facilities.

2. Gas into a group line is measured through a master meter.

3. Gas then is measured to an individual of the group from the group line through an individual delivery meter under a gas service contract.

4. Where there is a difference in the measurement of gas passing through the master meter and the aggregate measured through the various individual meters behind the master unit, the difference is identified as "leakage gas" and is prorated to the various individual meters served through the master unit.

5. Delivery of gas to a single customer through two or more meters from a common group line is calculated as delivery to one customer and the meter readings are pooled. Delivery to a single customer from a company line through two or more meters is not pooled but requires two or more contracts and is treated as two or more accounts. Similarly, a single consumer who receives gas through meters located on separate group lines must have contracts for meters on each group line.

Gas for domestic consumption incident to an irrigation contract is a part of the irrigation contract; but in cases where domestice consumers who are not irrigators take service from a company or group line, they receive gas under a general service contract.

The company engineering the group lines, and its specifications, required that no group line for irrigation be smaller than 2-in. ID. Larger pipe is specified if the potential load requires it. Pipe for use as service lines to farm residences or other buildings may be as small as 1.25-in. ID.

The design was based on a maximum of 50 psi at the master meter. Delivery is made to the customer through meters at utility pressures although many meters are equipped with compensating indexes and deliveries are made at 5 psi or 10 psi, respectively; but measurement of lines for multiple wells requiring initial pressure in excess of 10 psi is effected through meters equipped with volume pressure gauges.

Material for group lines was selected at the discretion of the group members. Some construction has been of standard steel pipe, welded, coldcoated, and buried at a depth of 30 in.; but many group lines were built of plastic pipe.

Many of the farmers prefer the plastic pipe because it is particularly easy to install. The trenches can be dug to the specified depth by power ditchers about as fast as a man can walk. Small crews can lay the pipe literallly as swiftly as the ground is ready for it. Two men can lay and join 30-ft lengths just about as fast as they can be taken off of a truck without power equipment. In addition, plastic pipe is finding acceptance due to: (1) favorable first cost, (2) resistance to corrosion and electrolytic action, and (3) the general ease of handling.

It would be a serious mistake to construe this as meaning metal pipe is receding from the picture. Metal pipe is essential for a vast number of applications where plastic pipe can never serve—particularly where strength and rigidity are prime criteria.

The company provided groups with construction specifications and specimen contracts were available for groups to use in dealing with pipe contractors, but contracts and their performance were strictly a farmer-group function, Mr. Curry explains.

Irrigation means a great deal to the West Texas region, as is obvious from the relative importance of this load to the gas company. Irrigation activities in the Floydada, Plainview, and Hereford areas date back several decades. The technological advancements made in pumping equipment, fuel utilization, the discovery of water-bearing sands, and the improvements in methods of completing wells all played a part in nurturing irrigation. Postwar, the impetus has been greatly speeded, as it has in all phases of agriculture and industry.

The irrigation areas have had a sustained 9-year growth rate somewhere in the neighborhood of 8%, according to Mr. Curry. Transition from dry land to irrigated land had increased the land value in ratios of 4 to 1, and even to as high as 10, to 1. The resulting high level of agricultural income is reflected in retail markets and in urban and business building. This is in sharp contrast to dry land farming, which Mr. Curry declares has been in "extreme difficulty for a period of no less than 5 years."

Predominating crops in the south plains are cotton and grain sorghums. Wheat and sorghums predominate in the area north of Tulia and Hereford. Alfalfa, potatoes, lettuce and sugar beets are important crops, and there is a considerable acreage in truck crops.

The growth in the area is being matched by the growth of Pioneer. The company is the outgrowth of a merger of several subsidiaries of Southwestern Development Co. Jan. 1 1954. On that date, the parent company was dissolved, and the operating companies — West Texas Gas Co., Amarillo Gas Co., Dalhart Gas Co., and Clayton Gas Co. were merged to form Pioneer Natural. ■

A SPECIAL GAS REPORT

Anti-trust ruling may affect gas industry communication system lease-maintenance agreements

The consent decree announced recently by the Justice Department in the government's anti-trust case against the American Telephone & Telegraph Co., and its affiliated Bell System companies, contains provisions which may have considerable effect on current and future lease-maintenance agreements between various common carrier communications companies, and gas utility and pipeline companies.

Because of the complicated provisions of the decree it is practically impossible to draw any conclusions as to its eventual application in the industry. The following, therefore, is a report on the decree, together with a brief summary of the available current thinking on how it might be interpreted in actual application.

By FRANK M. CHAPMAN • Publisher

THE consent decree announced by the Justice department on Jan. 24, under which the American Telephone & Telegraph Co. and its subsidiary, Western Electric Co., will make its patents available under equitable licensing procedures to any American concern desiring to use them, is also concerned with the matter of lease-maintenance activities on the part of common carrier communications companies. The bearing of the decree's provisions on these activities, however, and the extent to which they may alter present and future lease-maintenance contracts depends solely upon the interpretation of the related sections.

The decree resulted from an anti-trust action by the government against Western Electric Co. and AT&T; final judgment having been brought in the U. S. district court for the district of New Jersey. The section of the decree which deals with lease-maintenance activities (Section V) reads as follows:

> The defendant AT&T is enjoined and restrained from engaging, either directly, or indirectly through its subsidiaries other than Western and Western's subsidiaries, in any business other than the furnishing of common carrier communications services; provided, however, that this Section V shall not apply to (a) furnishing services or facilities for the plaintiff or any agency thereof, (b) experiments for the purpose of testing or developing new common carrier communications services, (c) furnishing circuits to other communications common carriers, (d) for a period of five (5) years from the date of this final judgment, leasing and maintaining facilities for private communications systems, the charges for which are not subject to public regulation, to persons who are lessees from defendants or their subsidiaries of such systems forty-five (45) days after the date of this final judgment, (e) directory advertising, (f) advice or assistance to other communications common carriers, or (g) businesses or services incidental to the furnishing by AT&T or such subsidiaries of common carrier communications services.

The decree sets forth a definition of "common carrier communications services" in another section (Section II-i). This section reads as follows:

> (i) "Common carrier communications services" shall mean communications services and facilities, other than message telegram service, the charges for which are subject to public regulation under the Communications Act of 1934, or any amendment thereof, or would be subject to such regulation thereunder if such a service or facility were furnished in inter-

state commerce; and shall also include any communications service or facility, other than message telegram service, the charges for which are or become subject to regulation under existing or future laws of any state, territory, or the District of Columbia, but only in the jurisdiction or jurisdictions in which the charges for such service are subject to regulation.

Although the provisions of the decree are open to interpretation, it appears that American Telephone & Telegraph Co. and its Bell System affiliates may not enter into lease-maintenance contracts with private users after 45 days from Jan. 24, unless the charges made under such contracts are subject to some form of public regulation. In addition, the decree would indicate that existing contracts in effect after this 45-day period must be terminated after five years unless under some form of public regulation. Furthermore, in defining "common carrier communications services," the decree explicitly points out that lease-maintenance operations can be a common carrier service and, thus, can be engaged in by the Bell companies if "the charges for such service or facility are subject to regulation."

Obviously, the crucial question revolves around the meaning of the phrase "subject to regulation." One Justice Department spokesman is reported to have said that the phrase means that charges for service must be regulated in the familiar "public utility" form (by requiring the filing of tariffs) before the Bell companies can lease and maintain equipment used in private systems after the designated five-year period. However, others hold that the phrase "subject to regulation" is satisfied by any form of regulation, such as a requirement that leases be filed with the state, even though tariffs are not required. This is indicative of the range of possible interpretations that may be given the decree.

The recent case before the California Public Utilities Commission involving a lease-maintenance agreement between the two southern California gas companies and the Pacific Bell Telephone Co. has an interesting bearing on the interpretation of this phrase. The California case arose when Southern California Gas Co. and Southern Counties Gas Co. proposed the sale of their combined radio communications facilities to Pacific Bell on a lease-back and maintenance arrangement.

In this case, the public utilities commission withheld approval of the arrangement until the annual charge for service arrived at between the gas companies and the telephone company was altered so that it would yield a fair return over and above all of the costs involved. In other words, it was required by the commission that the annual charge be fully compensatory to the telephone company.

The case stemmed from a prior decision by the commission in which the Pacific Telephone & Telegraph Co. was ordered to file, and secure authorization for, any contracts by which it proposes to provide any special services outside its regular offerings under filed tariffs. Thus, in assuming jurisdiction over the case, and the matter of establishing charges for lease-maintenance services, the California Public Utilities Commission recognized the proposed service as a public utility service.

As a result of this case it would appear that the lease-maintenance agreement entered into between the two southern California gas companies and the local Bell company satisfied the phrase "subject to public regulation," at least insofar as the state commission is concerned.

However, the consent decree raises a question with regard to the validity of state jurisdiction. There is room for argument, apparently, as to whether or not the states may regulate the charges for a lease-maintenance agreement. The federal government, through the Federal Communications Commission, has pre-empted the field of radio communication regulation, recognizing that radio transmission not being confined by state borders is in interstate commerce. If it could be argued that lease-maintenance activities are so closely aligned to radio communications that they are an intrinsic part thereof, it would appear that the federal government and not the states is the proper entity to provide regulation.

In the California case the state public utilities commission recognized the possibility of federal authority and jurisdiction, but pointed out that "whatever may be the authority and jurisdiction of the FCC, the parties cannot enter into the proposed arrangement without the approval of this Commission." A spokesman for one of the parties to the action expressed the view that while the FCC held jurisdiction over matters of transmission through its licensing procedures, the matter establishing charges for service was purely a local matter, and therefore, subject only to local regulation. Licenses are, of course, retained by the private user under a common carrier lease-maintenance arrangement.

Federal regulation, however, poses an additional problem if it is assumed that FCC jurisdiction is extended beyond its current licensing powers to include the filing of traiffs. At present, the FCC requires the filing of tariffs only by licensees of common carrier radio stations and persons engaged in other strictly common carrier transmission. It would appear, therefore, that common carrier companies could not file tariffs with the FCC for leased equipment used on private frequencies.

New rules would apparently be required to permit the common carrier companies to file tariffs for lease-maintenance agreements with users operating on private radio frequencies. Although there is some doubt that the FCC could promulgate such rules under the Communications Act, it might be resolved by holding that lease-maintenance agreements are so akin to rendering a communications service as to be, in fact, such a service by their very nature.

These, therefore, are some of the problems presented by the new consent decree. Lacking interpretation of the complicated provisions of the decree it is difficult to visualize the extent to which it may affect lease-maintenance arrangements. With an eye to possible difficulty in interpretation, the Justice Department included a provision (Section XVII) whereby the U. S. district court for the district of New Jersey will retain jurisdiction of the matter indefinitely. This provision should add markedly in expediting interpretation. ■

A look at the equipment

By C. W. WARNER • Cutler-Hammer Inc., Milwaukee

IN Part 1, it was developed that the three fundamental elements of a gas mixing control system are:

(1) Some system of volumetric proportioning.
(2) Proper calorimetric equipment.
(3) A Btu adjusting mechanism.

To fully understand these components, it is well to take a more detailed look at some of the equipment that experience indicates can fulfill the requirements for scientific gas mixing control.

Volumetric proportioning system

This phase of controlled mixing of gases includes equipment in the form of pressure regulators, flow controllers, differential pressure controllers, ratio regulators, butterfly and other types of control valves, and various types of gas pumping equipment. Obviously, a wide variety of devices is available in each of these categories. For the purposes of this discussion, the description will be limited to an essential proportioning controller produced by the Askania Regulator Co., Chicago, Ill.

Ratio Controller. A ratio controller is a device for the control of flow or pressure in direct relationship to a second flow or pressure.

The Askania jet pipe relay is the nucleus of all of these hydraulic regulators. *Fig. 4* shows a schematic sketch of a ratio controller. The jet pipe relay converts a signal from the source of measurement into the motion of the hydraulic cylinder that operates the final control element.

The jet pipe itself is a pivoted, stainless steel nozzle that is free to move horizontally through a small angle. Oil (usually at 100 psig) is supplied to the jet pipe through the hollow vertical upper-bearing. The jet pipe discharges this oil at two closely adjacent orifices that are connected to opposite ends of a double-acting hydraulic cylinder.

When the force developed by the measured signal on one side of the jet pipe balances the counter-acting force on the other side, the jet pipe directs its stream of oil midway between the two orifices. With the jet pipe in this center position, the recovered pressures at the two orifices are equal. When the forces acting on opposite sides of the piston are equal, the piston is stationary.

Any unbalance between the measured signal and the counteracting force moves the jet pipe toward one orifice and away from the other. This unbalances the forces at opposite ends of the cylinder, and the piston moves to operate the control valve or damper. The principle involved is the conversion of kinetic energy (velocity pressure) into potential energy (static pressure). If the jet pipe is fully deflected toward one of the orifices, the pressure recovered at that orifice will be about 90% of the inlet pressure.

The position of the power piston is completely independent of the value of the measured signal. This value governs only the rate of movement of the piston. When the measured signal and the counteracting force are in balance, the piston is stationary, regardless of its

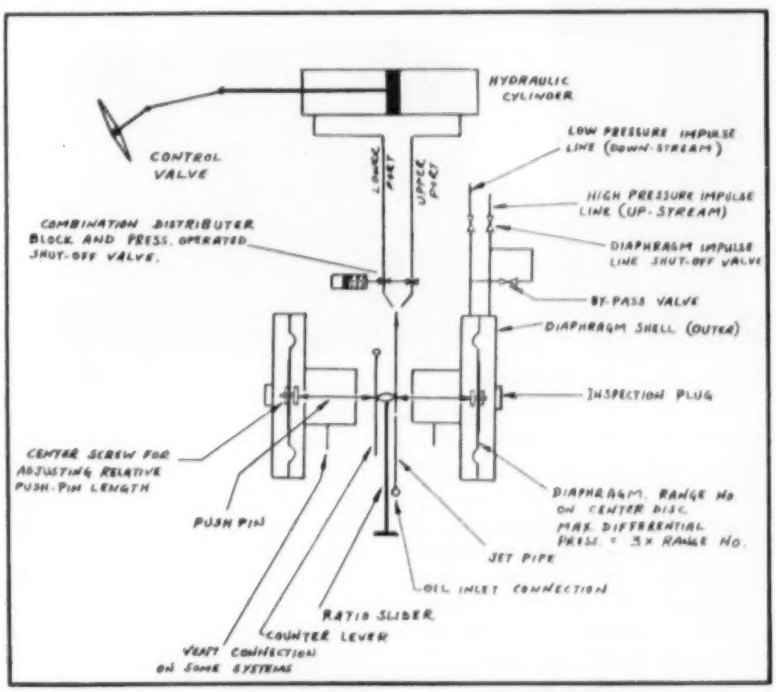


Fig. 4. Schematic diagram of a ratio controller.

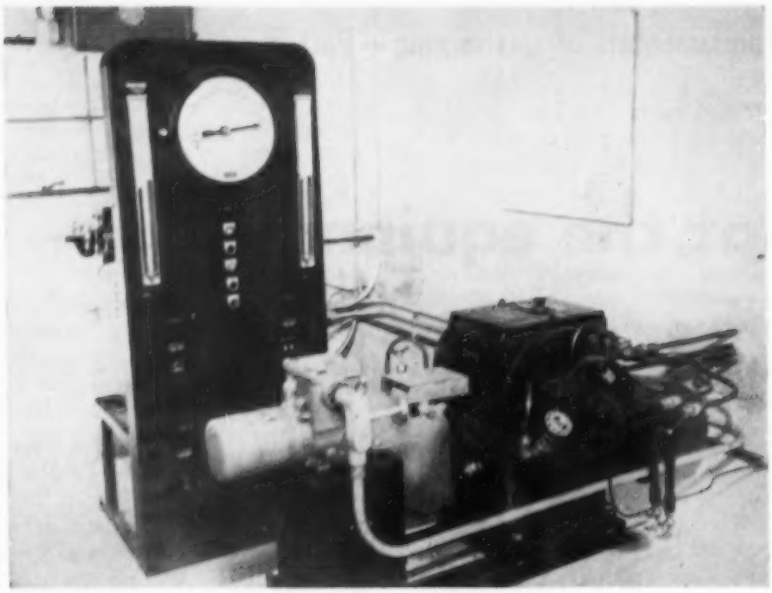


Fig. 5. Unit ratio controller with Btu adjuster.

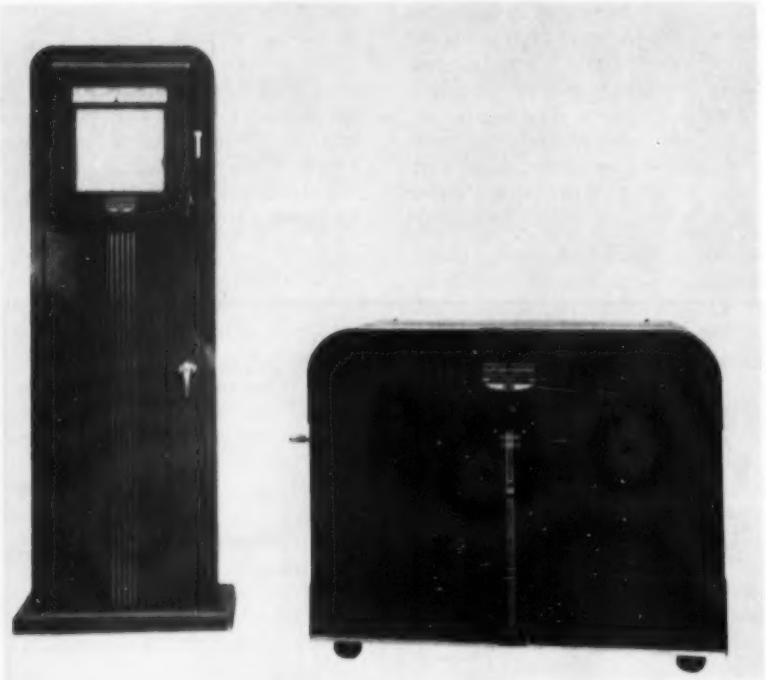


Fig. 6a. Recording calorimeter.

position. This mode of control is called *proportional-speed floating* control: "proportional-speed" because the speed of correction is directly proportioned to the amount of error; "floating" because there is no fixed relationship between the value of the measured variable and the position of the final control element.

The measured signal is converted into a force to position the jet pipe by means of a "signal system" such as a diaphragm, bellows, bourbon tube, or some electrical device.

A handwheel is provided on the ratio regulator. This is used to change the position of the ratio slider in order to change the flow ratio being maintained. The slider position may be changed while the regulator is in operation without disturbing the continuity of control.

The relationship between the mechanical movement "Y" and the resulting ratio "R" of the opposing force is expressed by:

$$R = \frac{1.97 + Y}{1.97 - Y} \text{ or } Y = 1.97 \frac{R - 1}{R + 1}$$

By replacing the hand wheel with a reversing motor drive, it is possible to adjust the ratio slider automatically from an instrument.

Fig. 5 shows a typical ratio regulator of the Unit type with self-contained oil pump provided with a motor drive on the ratio slider.

Pressure difference controller. By replacing the diaphragm system on the secondary side of the ratio controller with a spring loading with hand wheel adjuster, the ratio controller can be converted to a pressure, flow or differential pressure controller. In this case, the counter lever and ratio slider normally would not be included in the mechanism.

Again, by replacing the handwheel with a reversing drive through a motor adjuster, it is possible to vary the maintained differential in order to secure some desired characteristic. Later the application of pressure difference control to gas mixing problems will be illustrated.

In order to change the controller to make it suitable for pressure regulation, it is merely necessary to eliminate the one diaphragm connection to the inside of the diaphragm. The pressure connection would then be made downstream of the control valve.

Calorimetric equipment

Analyses of gas mixing control problems show that the logical basis for the control is the measurement of the final mixture heating value. Precision measurement of the heating value of gas is comparatively simple, but unfortunately considerable time is necessary in making an accurate determination. In fact, time and accuracy seem to be directly related. The greater accuracy secured in the determination, the longer the time interval involved.

Three instruments that will be discussed for controlling gas mixing are: (1) the recording calorimeter, (2) the Calorimixer, and (3) the Thermeter, products of Cutler-Hammer.

Recording calorimeter. This instrument is a precise continuous calorime-

ter that indicates and records the heating value of various commercial gases.

In general, it consists of two parts *(Fig. 6)*: a tank unit in which the actual measurement of heating value takes place, and a recorder, which gives the indication and graphic record of the heating value. The tank unit is constructed so that metered quantities of gas and air at the same temperature, pressure, and saturation condition are delivered to, and burnt in, a burner. The liberated heat from the combustion of the gas is imparted to a separate stream of air. The temperature rise of this air is used as a measure of the heating value. In the burner, the flue products are isolated from the heat-absorbing air and are cooled down to substantially the initial temperature at which the gas and air were metered. Thus, the water formed in combustion is condensed to the liquid state. Consequently, the recording calorimeter makes the measurement of heating value substantially in accordance with the generally accepted definition.

The recorder translates the temperature rise of the heat absorbing air into an indication and record of the gas heating value. Resistance thermometers and a self-balancing Wheatstone bridge are used for this purpose. The scale and chart are both calibrated in Btu per standard cubic foot.

The instrument time lag is so large that it can be used in only a few special applications as the primary controller in a gas mixing system. It does have a definite control function in many applications.

In those gas mixing installations involving large quantities of mixed gas it would be desirable to provide final control with the precision and accuracy obtainable from the recording calorimeter. This can be accomplished by using the instrument to supervise the Calorimixer. Automatic control in this case is not handicapped by the long time lag of the calorimeter since the corrections required by the Calorimixer normally take place very slowly. Thus, the small corrections required can be made satisfactorily by the calorimeter.

Calorimixer. The general principles of operation are the same as for the recording calorimeter. However, the instrument has been *designed as a controller* and, consequently, the instrument time lag has been reduced to an absolute minimum. This requirement results in a different arrangement of parts, a different method of measuring temperature rise, and the inclusion of various features required for an automatic controller. *Fig. 7* shows a general view and a flow diagram.

The instrument consists of three major parts: a tank unit, in which the heating value measurement takes place; a recorder, which provides an indication and graphic record of operation and includes certain of the automatic control features; and a control panel with the necessary electrical equipment.

In the Calorimixer the determination of gas heating value does not involve a separate supply of heat-absorbing air. The air meter delivers a large quantity of air to the burner to support the combustion of the gas sample and to provide an excess, which is mixed with the products of combustion to give a reasonable temperature rise. Thus, the heat liberated from the combustion of the gas sample is imparted to the mixture of air and flue products so that the temperature rise is an indication of gas heating value. The temperature of this mixture is sufficiently high so that none of the water formed in combustion is condensed. In addition, changes in gas composition also cause a variation in the specific heat of the flue products. As a result, the Calorimixer indication is more nearly a function of net heating value rather than total heating value; and the readings are further affected by flue gas composition.

The recorder of the Calorimixer has a scale and chart which are calibrated in approximate percentage variation from the control point. A control contact mechanism in the recorder is used to set up electrical circuits to initiate the various functions required of an automatic controller. This mechanism includes high and low direction contacts, high and low alarm, and a contact for automatic ignition of the flame in the Calorimixer burner.

In any gas mixing control system, it is necessary to match the rate at which corrections are made to the rate at which the controlled factor can be measured. It is obvious that time is involved in the measurement of gas heating value. To the time lag of the instruments themselves must be added the transport lag in bringing the required gas sample to the instrument. In the Calorimixer, this matching of corrective impulse to rate of measurement of the variable being controlled is secured through a special interrupter

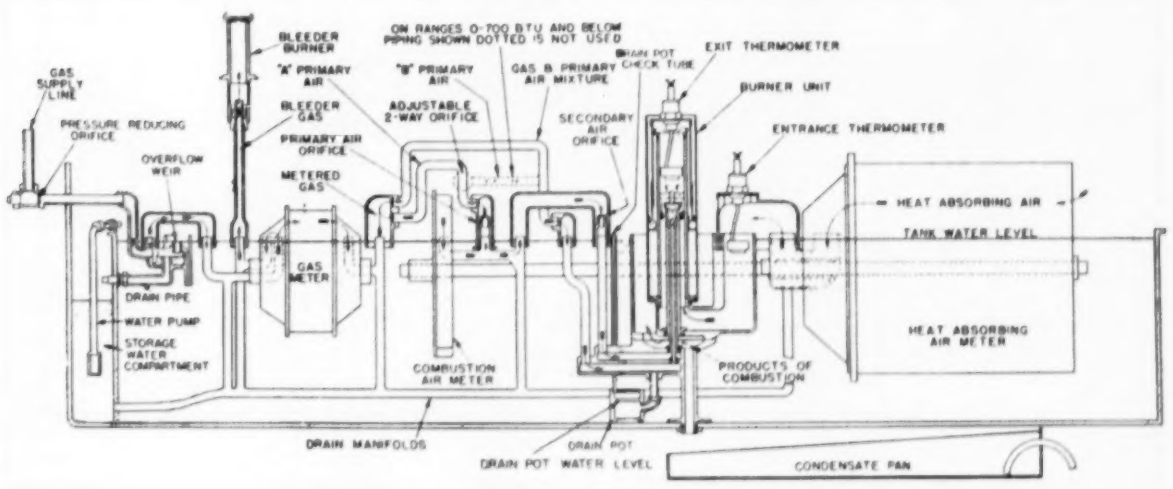


Fig. 6b. Flow diagram for calorimeter.

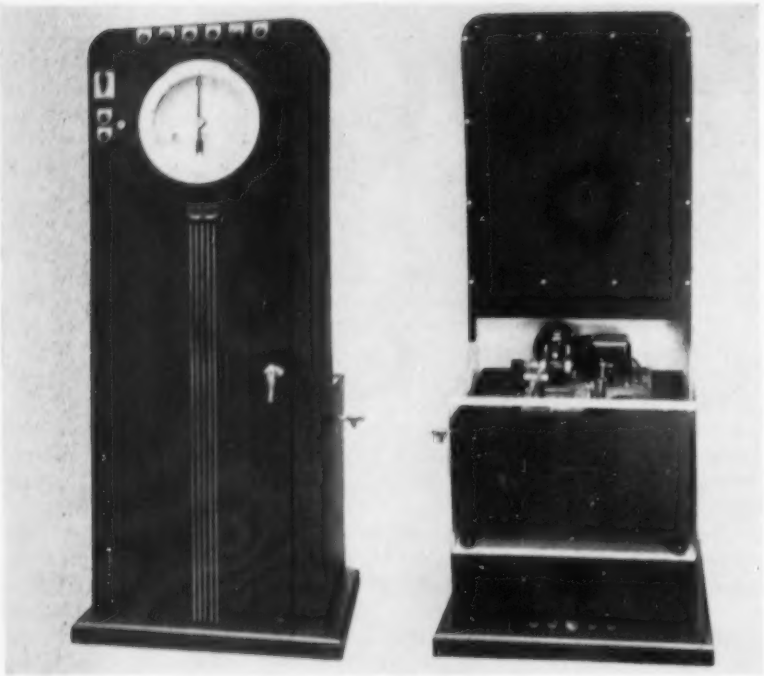


Fig. 7a. Calorimixer.

mechanism. This mechanism permits a periodic adjustment (once every 20 seconds) to be made to return the gas heating value to the control point. In addition, through a linkage to the recorder, the magnitude of the adjustment will be proportional to the deviation from the control point, up to a limiting value. Sufficient flexibility is provided in the adjustment of the mechanism so that corrections can be made in a given application so that satisfactory control will be secured without hunting.

Thermeter. The Thermeter was designed to meet the requirements for a less expensive calorimixer. At the same time, its speed of response to changes in gas heating value have made it very useful as a controller for many gas mixing systems.

The principle of operation is the same as for the Calorimixer. In fact, the Thermeter might actually be considered a Calorimixer with improvements to increase its reliability and accuracy as a calorimeter. As in the case of the Calorimixer, the measurement of heating value is more nearly a func-

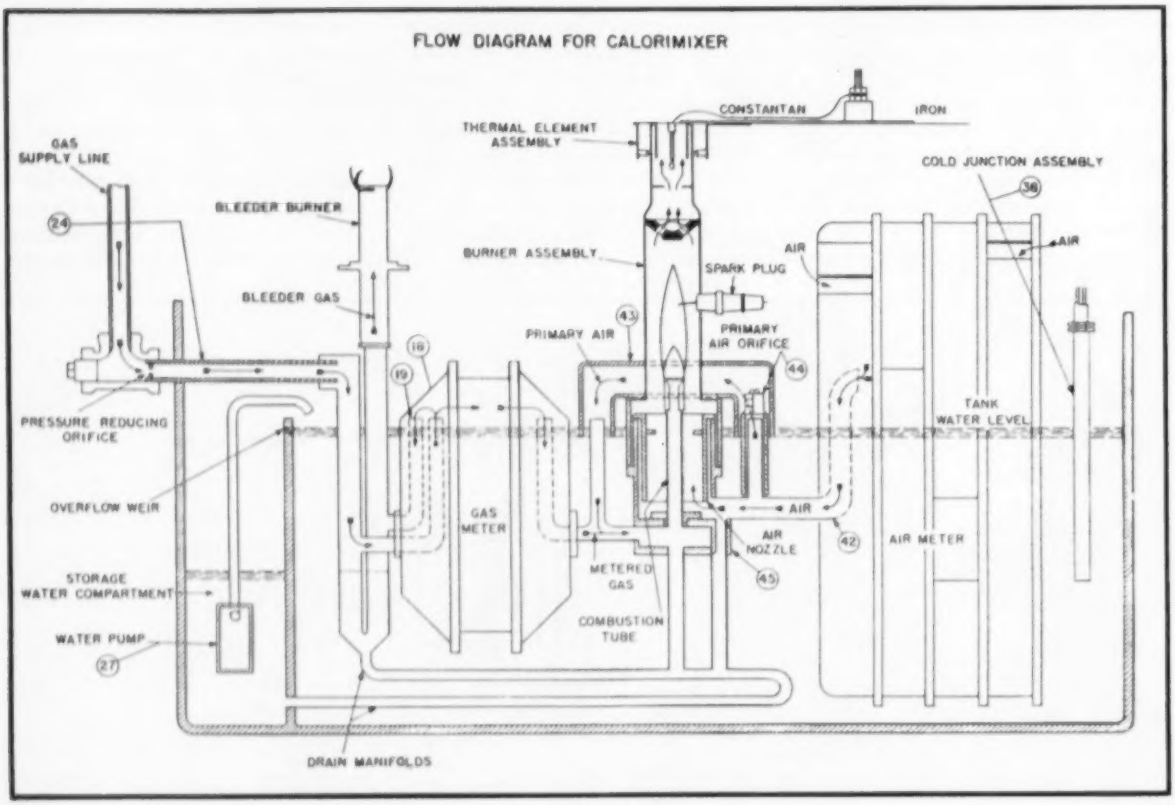


Fig. 7b. Flow diagram for calorimixer.

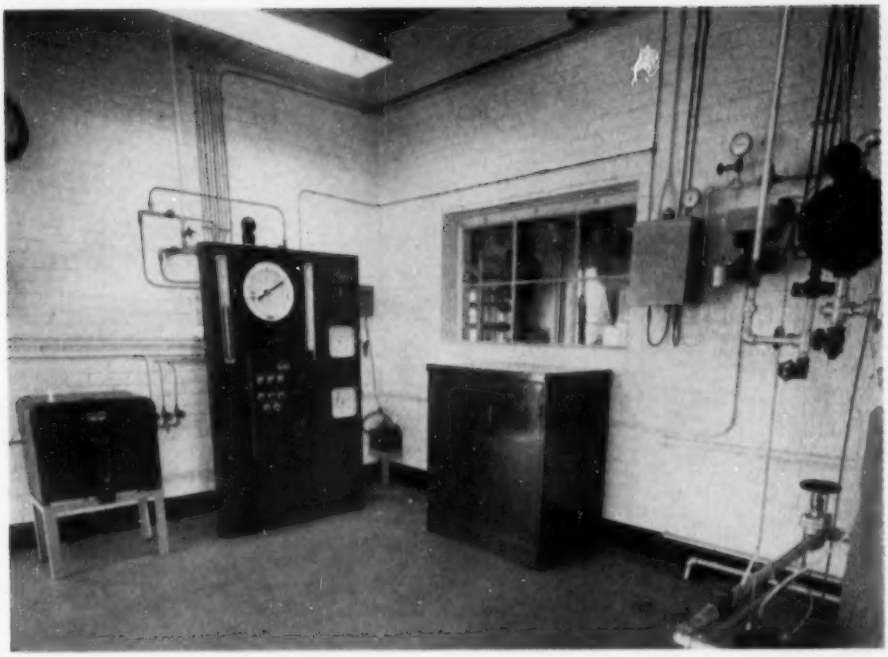


Fig. 8.
A thermeter installation.

tion of net heating value rather than total value. However, in practically all applications, the Thermeter is calibrated to indicate and record in total heating value per standard cubic foot. Consequently, the recorder circuit of the Thermeter must be designed and adjusted to suit the composition of the gas on which it will be used. This represents one of the most important operating differences between the calorimeter and the Thermeter. A calorimeter can be used on any gas providing the range is correct, while a Thermeter must not only have the correct range, but also must be calibrated for the specific gas to be tested.

The Thermeter consists of two parts: a tank unit in which the measurement takes place, and a recorder in which this measurement is translated into an indication and graphic record of heating value. The recorder is a round chart, self-balancing potentiometer with special circuit similar to that used in the Calorimixer. The recorder range is of the suppressed zero type, since no zero is required for test or calibration. Thus the scale and chart range are from 50% to 100% of the full scale range of the instrument. In the case of a 1200-range instrument the scale and chart will show readings from 600 to 1200. The results obtained from the Thermeter, as in the case of the calorimeter, are directly in heating value per standard cubic foot without requiring any correction factor. The instrument is illustrated on *Fig. 8*.

Since the instrument has certain limitations such as effect of gas composition on accuracy, the accuracy and reliability of the temperature measuring system, etc., these points must be considered in making an application to a specific gas mixing problem.

In order to provide automatic control features, the Thermeter recorder is provided with a control contact mechanism and an interrupter assembly. Two contacts provide direction control for the device to be adjusted to control mixture heating value and the third contact permits operation of a high-low alarm from the Thermeter indication. A special cam is used to adjust the interrupter mechansim in terms of deviation of the instrument indication from the control point.

The interrupter mechanism provides an adjustment to the device controlling

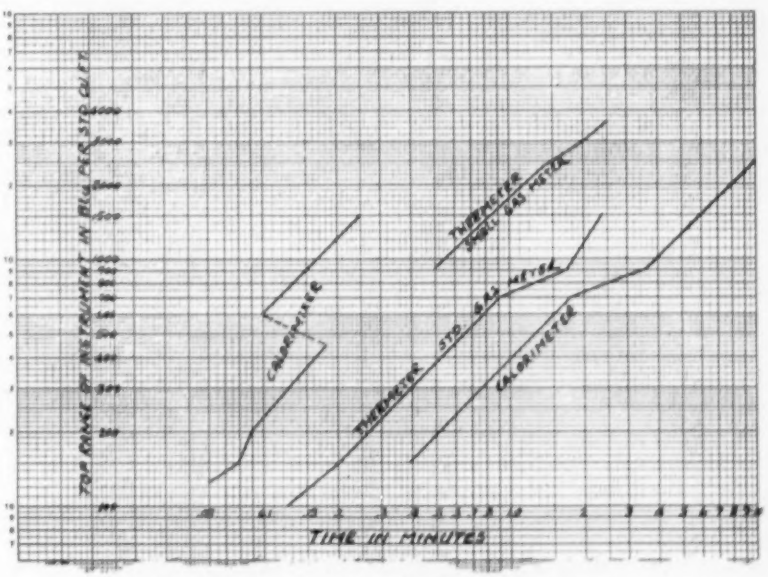


Fig. 9. Transport log in tank unit — inlet orifice to burner.

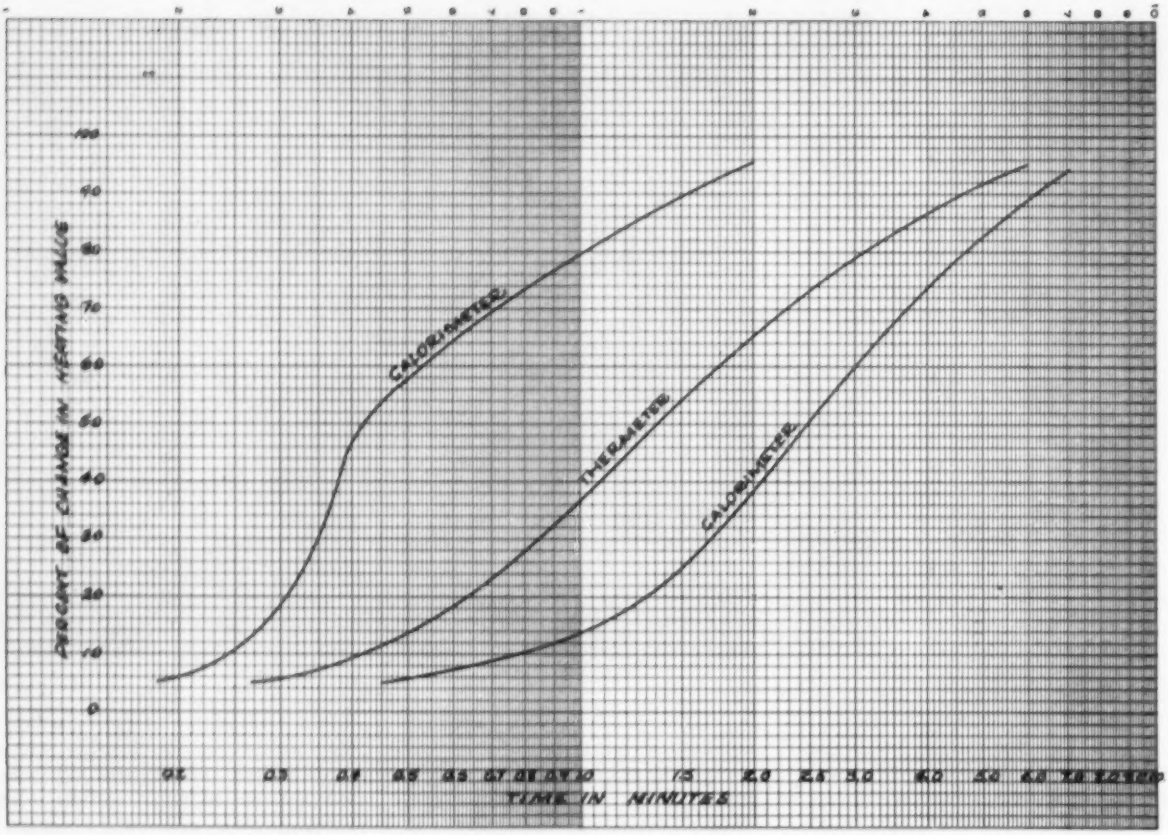


Fig. 10. Thermal time lag — time, in minutes (after new gas reaches burner) vs. percent of change shown.

mixture heating value. A knurled wheel is provided to give convenient manual adjustment of the control point. A scale on the engaging disc gives a reference in terms of scale calibration for the actual setting.

Instrument time lag

Figs. 9 and *10* show the characteristics of these three instruments in terms of time-to-determine-a-change-in-heating-value. Data are shown on the basis of separating this time lag into two components; one, the actual transport lag in the instrument from the inlet orifice to the burner, and the other, the thermal lag in the burner.

The transport lag will depend upon the range of the instrument since gas meter speed depends upon this range. Thermal lag will, of course, be the same for all ranges. The total time lag for any individual range instrument must be the sum of these two factors.

In actual application of this information to any control problem, it is necessary to add to the instrument time lag, the time lag (transport lag) in the sample line and the time in the system itself from the point of control to the sample point.

The lag in the system itself from the point of control to the sample point can normally be neglected since the transport time is usually very short. However, in those problems in which a very wide range in flow must be covered, or where gas velocities are low (large pipe, small volume flow), it will be necessary to check the time of the system to the sample point.

The most important characteristic of the Calorimeter as a controller—speed of response to change in heating value—is clearly illustrated by *Figs. 9* and *10*. Thus, for a 1000-Btu range, the time required to show 5% of the change in heating value is only about 20 seconds. However, in securing this speed of response, some sacrifice in accuracy was necessary. Consequently, the instrument is normally used as the primary controller under the supervision of a recording calorimeter.

The curves in *Figs. 9* and *10* indicate that the speed of response to changing heating value of a Thermeter is considerably better than a recording calorimeter. Thus, a 1200-Btu-range Thermeter will show 5% of the changes in heating value in about 0.94 minutes or approximately 56 seconds, while a 1200-range calorimeter will require 5¼ minutes or approximately 315 seconds. To show 50% of the change, the same Thermeter will take about two minutes, while the calorimeter will require 7.3 minutes. From the standpoint of a controller, the Thermeter will be much more suitable. ■

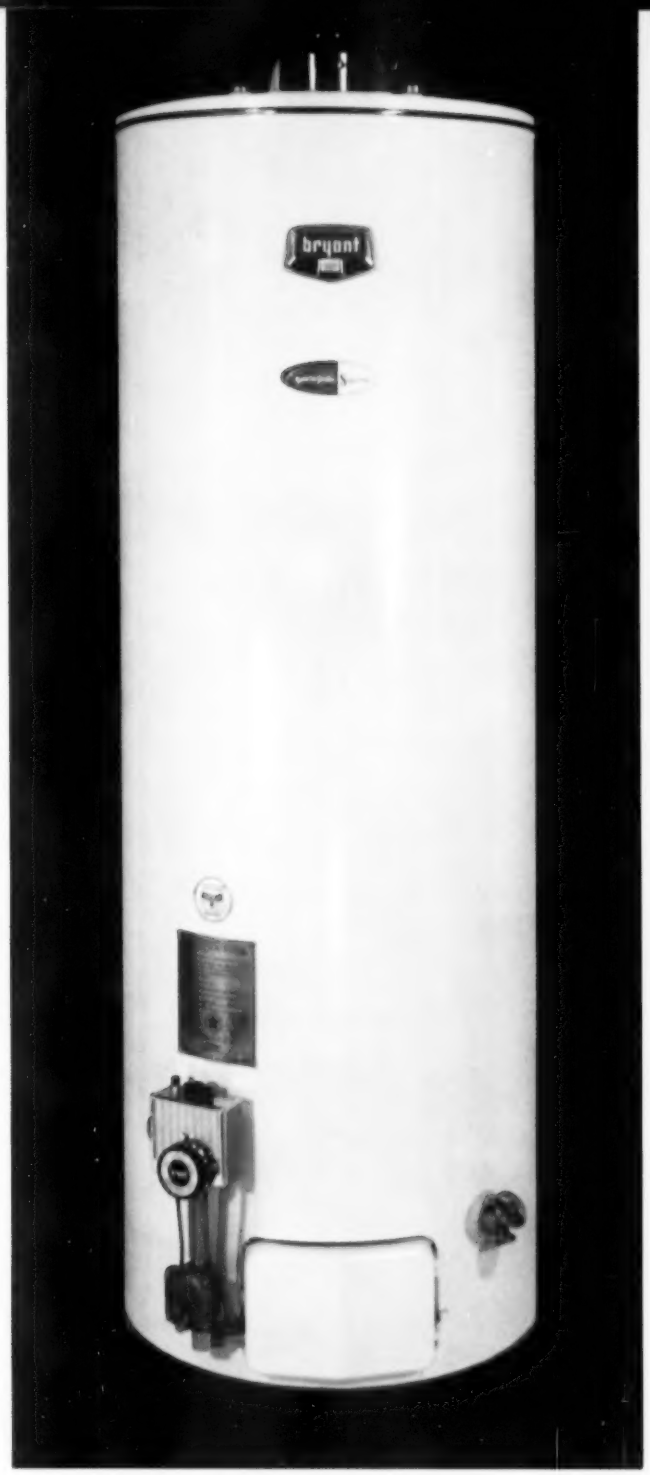
EDITOR'S NOTE:

Part 3 will cover subjects relating to typical gas mixing control systems. Specific subjects that will be presented are:

(1) Simplified control with motor-operated valves.

(2) Control with volumetric proportioning.

(3) Control using differential pressure regulators for proportioning.



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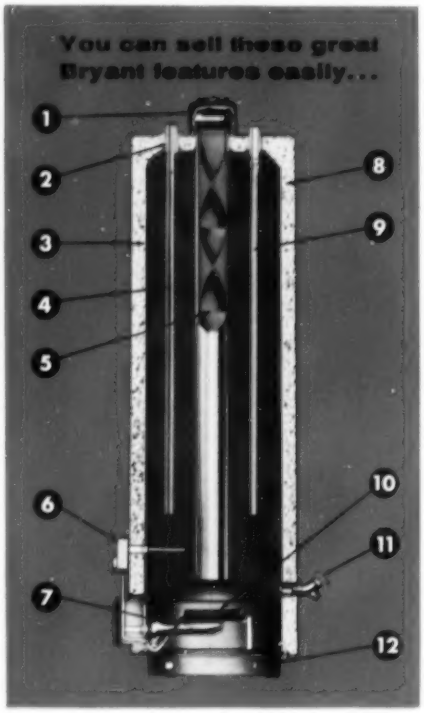

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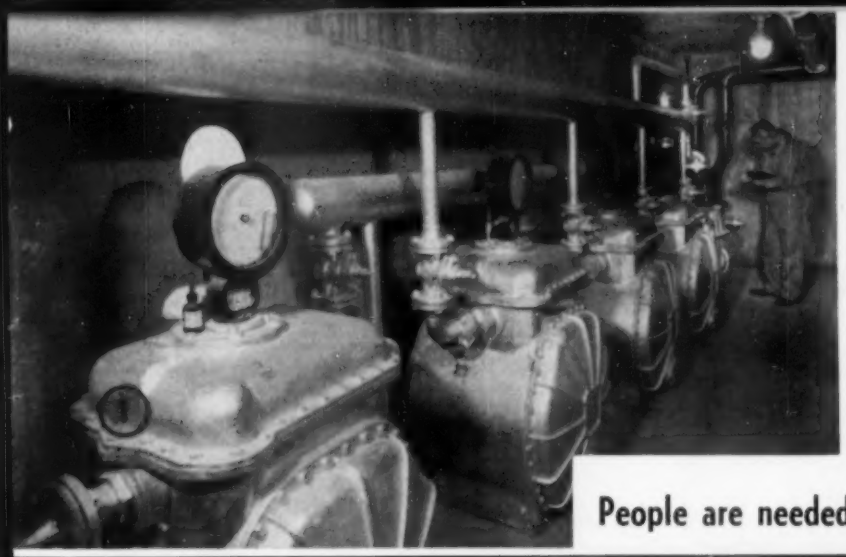


Gas runs new Dallas hotel

People are needed too, but gas does a big job

FROM top to bottom and throughout every area of the smart new Statler Hilton hotel in Dallas, gas is an ever-present servant, providing year-round air conditioning, cooking, hot water, laundry and numerous other needs on a 24-hour schedule.

Lone Star Gas Co., which furnishes fuel to the building, estimates that 205 MMcf of gas will be consumed annually by the more than 100 pieces of equipment—directly gas-fired or operated by gas-generated steam. This equipment ranges from mammoth boilers to deep-fat dryers and from clothes dryers to bread toasters. A giant gas incinerator in the basement burns all combustible trash accumulated in the hotel.

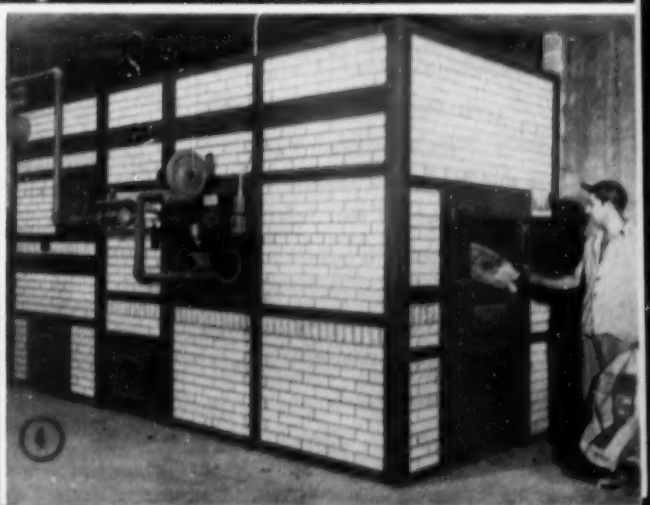
In addition to the 205 MMcf, an additional 7 MMcf of gas will be used each year for vast cooking operations in kitchens and bake shop. These culinary centers are equipped with some 80 gas or gas-generated steam units which cook food, sterilize dishes and utensils, and retain heat in foods ready to be served. ■

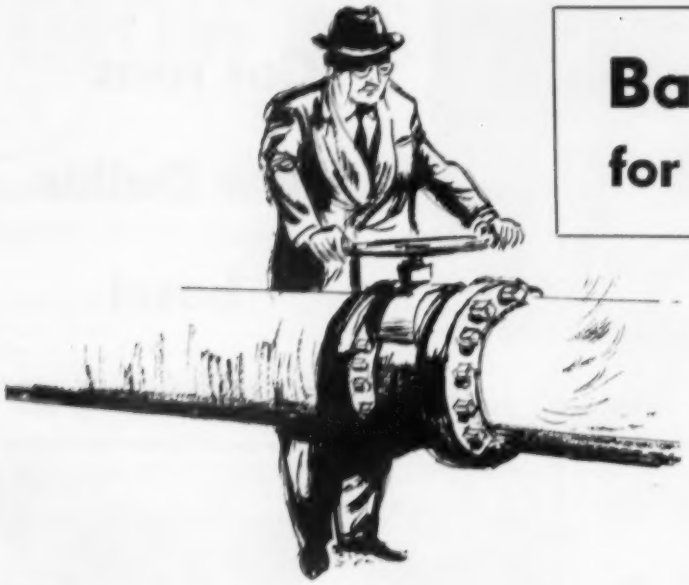
1 This manifold installation of five large capacity, positive meters measures the 212 MMcf/yr gas load delivered by Lone Star to the new Statler Hilton hotel in Dallas.

2 Equipment in the bake shop, where all breads, rolls, pies, cakes, etc., are baked, consists of three double-deck gas ovens (background), which can turn out 1000 rolls in one baking.

3 Rotating vats wash bed clothing, towels, linens, in the fully equipped basement laundry of the new $16 million hotel. Gas-heated wash water reaches a temperature of 130°.

4 This giant gas-fired incinerator burns all combustible trash accumulated in the hotel. The trash reaches a basement bin through a chute which has an opening on each floor of hotel.





Bank financing for the gas industry

By **RUSHTON L. ARDREY**
Senior Vice President

and

E. E. MONTEITH JR.
Vice President - Petroleum Engineer
Republic National Bank of Dallas

IN order to understand the role of bank financing for the gas industry, a brief summary of the working capital and fixed assets requirements of the gas industry in general will be helpful. The working capital required to operate a gas utility is very small in proportion to total capitalization—6% to 15%, dependent upon what cost items are to be covered. The fixed assets of plant, property, and equipment of a natural gas utility or transmission company account for 85 to 94% of total capital requirements. Thus, the major financing is that necessary to carry the costs of plant, property and equipment.

The tremendous expansion of the natural gas industry since 1947 to meet unprecedented demand has caused a correspondingly phenomenal demand for financing the burden of cost of fixed assets. Since gas contracts and gas profits are spread essentially equally over 20 years, and the transmission and distribution equipment is by nature long-lived, this financing to carry fixed asset requirements is necessarily long-term lending. Furthermore, this type of lending is in huge sums. This combination of long-term, huge-sum lending is a natural invitation to the insurance companies.

During the period of 1932 to 1947, the gas utility and transportation companies have added new and replacement facilities with financing from internal sources, such as depreciation accruals and undistributed earnings. Soon after World War II, many large gas transmission companies were organized to carry the big supply of relatively unmarketed gas of Texas, Louisiana, Oklahoma, and Kansas to the heavy industrial and population centers of the north and northeast. These companies were financed on the basis of debt and equity security issues. Debt issues in the form of first mortgage pipeline bonds, financed largely by insurance companies with amortization spread over 20 years, accounted for 77.5% to 89.5% of the total funds raised. Where new capital was formerly raised by use of equity securities, it must now be raised primarily from debt securities.

This change in the investment market from equity security to debt security can be charged primarily to heavy income taxes, which immediately cut down the liquid savings of the old investor group, and second, to lack of interest in utility investment as a hedge against inflation. During the depression the American people became security-minded, and the high income taxes during and after World War II afforded little chance of accumulating savings. People turned to insurance for security and the total assets of the life insurance companies began increasing at phenomenal rates. While legal restrictions limit the life insurance companies on investments in common stock and preferred stock, the insurance companies have become the big source for mortgage bonds, and thus, are the big banker for the gas utility and gas transmission companies. Other sources of investment money for common and preferred stocks are investment companies, educational institutional funds, and the pension and profit-sharing funds which are becoming increasingly popular today.

The borrowing of debt capital is

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Commercial banks play an important role in financing gas production, gas transmission companies, and gas distributing operations. Republic National Bank of Dallas has pioneered in this specialized phase of banking. It is brought out that federal regulation of producers is detrimental to loans secured by gas production; hence, this will curtail the number of new gas wells drilled.

TABLE 1. Sources of new money for gas operating and holding companies:

		% of Total
Sale of common stock	$ 242 million	9.6
Sale of preferred stock	327 million	12.9
Sale of debt issues	1,959 million	77.5
	$2,528 million	100.0

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TABLE 2. Sources of new money for straight gas operating companies:

		% of Total
Sale of common stock	$ 28 million	2.6
Sale of preferred stock	85 million	7.5
Sale of debt issues	971 million	89.9
	$1,084 million	100.0

made relatively easy by the exceptional stability of gas utilities by virtue of the long-term contracts for gas reserves, the long life of the physical facilities, and the long-term sales contract for the gas to distributing and electric utility companies with excellent credit ratings. Thus, after the initial promotional stage, there is very little risk involved in evaluating the credit of a gas transmission company.

The heavy demand for financing on debt security issues of gas companies is documented in *Table 1*. In 1954, gas operating and holding companies raised new money from the sources shown in the table.

In analyzing the debt issues, only $49 million, representing 2.5% of the debt and 2% of the total issue, was raised on notes to banks. Straight gas operating companies showed the same general trend in 1954 as evidenced by the sources of money shown in *Table 2*.

In reviewing the debt issues, only $41 million, representing 4.2% of the debt and 3.8% of the total issue, was raised on notes to banks. This is a drop in the banks participation of debt issues from 21.4% in 1950 to 4.2% in 1954. Bonds and debentures have become popular with the company organizers because of the smaller immediate payments required. These figures clearly show that financing of security issues of gas companies is primarily done by the investing public and more particularly institutional investors, such as life insurance companies.

As the demand for gas to fill the new lines increased, the search for gas represented in gas well completions began to show a modest increase in 1953 and 1954. The 4000 gas well completions in 1954 show this activity when compared to 2800 in each of the years 1948, 1949 and 1950. This increased the demand for loans on gas properties accordingly.

Loans secured by gas production

Loans secured by gas production may be classified according to their purpose in two groups. One class of gas loans would be to finance gas producers in development of gas properties. The other class of gas loans would be a loan to finance the acquisition of gas properties. The percentage of gas loans to total petroleum loans has increased from about 5% in 1949 to 20% in 1955.

Since the early days of east Texas, our bank has been in the forefront of loans secured by oil reserves. It was a natural and logical step to loan against gas reserves once the reserves had a stable market in terms of demand and price. The Hugoton and Panhandle gas fields were the first large reserves to receive attention from gas purchasers and the first gas loans were made against these reserves based on very low contract prices. The Carthage field in east Texas was the next large gas reserve to receive attention from gas purchasers, and gas development loans have grown more popular ever since.

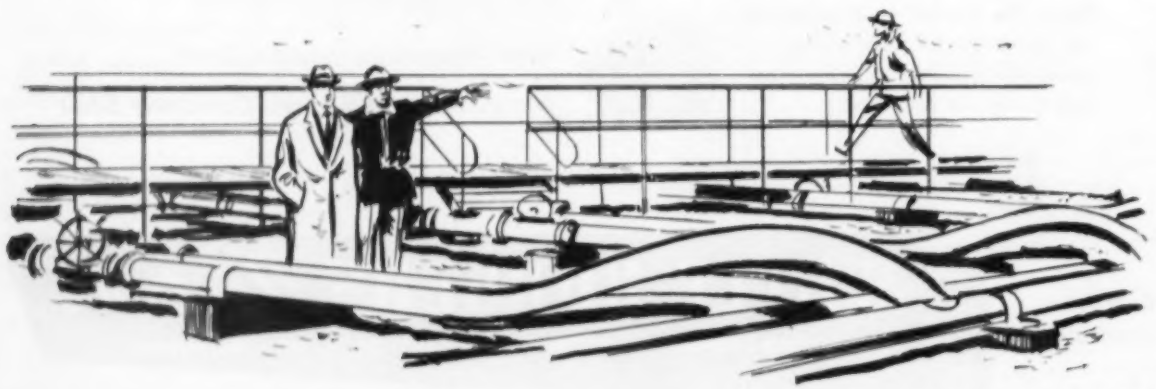
As in the case of an oil loan, the amount of the loan is based on the value of the present worth of the net revenue from the gas reserves and the payout determined by rate of depletion of reserves. The great difference between an oil loan and a gas loan is the longer term of the gas loan if the same 50% of the present worth of the reserves is used as a lending criterion. Thus, if a gas reserve were depleted over 20 years at equal rates, the present worth of this 20 years' reserve at 5% discount factor would be 12.8 years, which would allow a loan of 6.4 years on a safety factor of 2; whereas, an oil loan would normally have a quicker payout in relation to present worth. Other factors favoring gas loans before the Phillips ruling of the FPC were the guaranteed price including escalation in contract form and often a minimum guaranteed take in the form of a "take-or-pay" clause.

Another type of bank loan on gas properties have been loans against gas payments reserved and sold as part of an overall transaction or sold to anticipate income. The creation of these gas payments is decidely different, but the evaluation and general lending technique is the same.

Aside from the FPC, gas loans would be most desirable because of the probable higher-than-contracted rates of take and stability of consumer demand in less prosperous times for heating and cooking.

The role of banks in financing transmission companies

Of the several types of bank loans made to gas transmission companies, the most important is that of first maturity loans on long-term debt. While these are not secured by assets as directly as the mortgage bonds created



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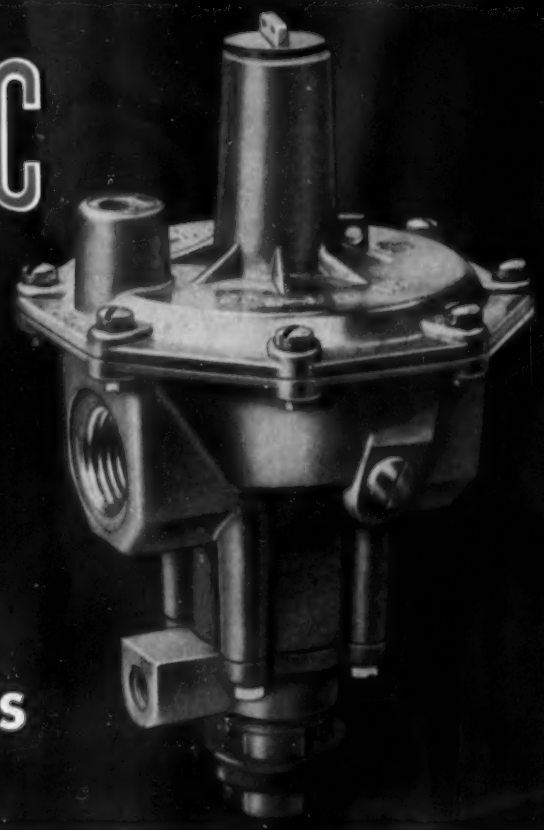

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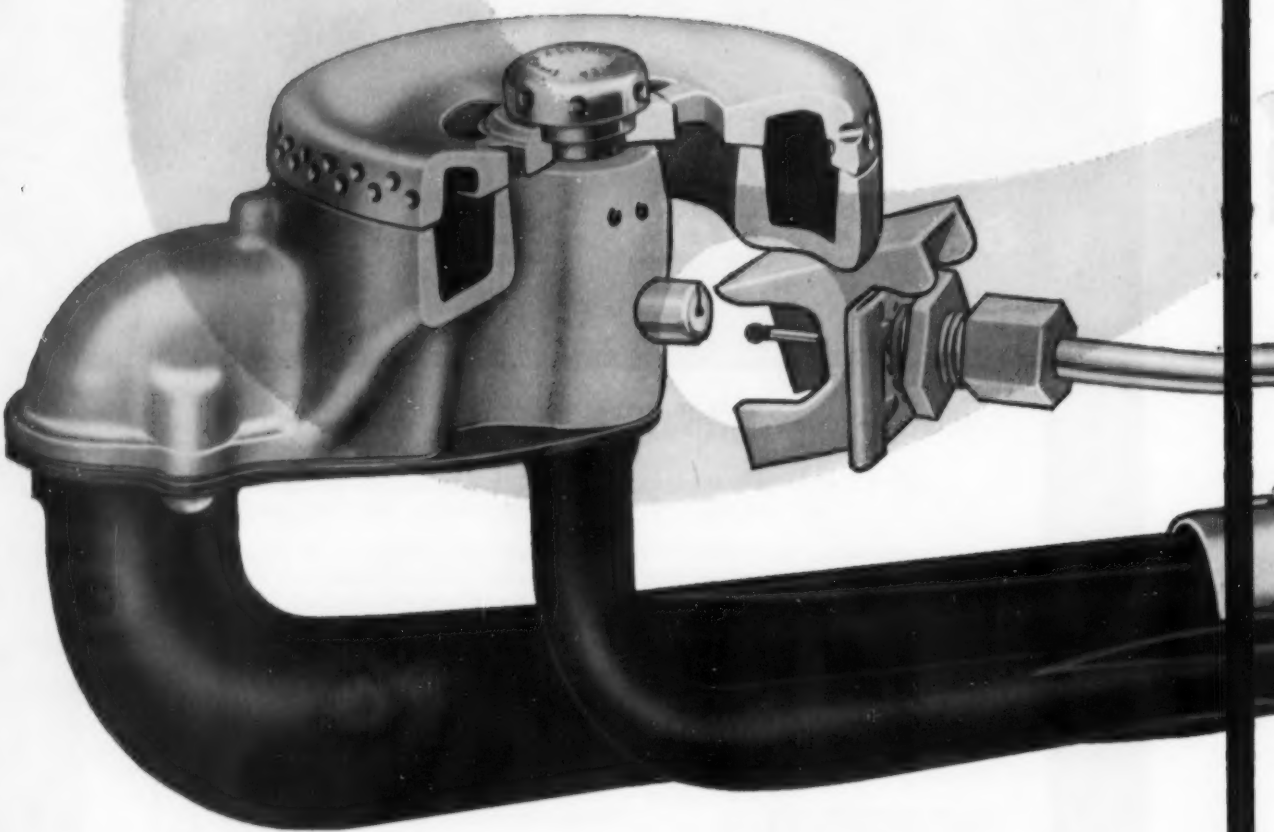

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when a new security is issued, the bank loan agreement, usually involving unsecured promissory notes of the company, obligates the company to specific performance in terms of raising money by sale of stock and restricts the company from dilution of assets and ownership, payment of unwarranted dividends, and additional indebtedness. These first maturities are thus indirectly secured by assets through the loan agreement and the maturity is usually limited to a maximum of five or six years, whereas, the first mortgage pipeline bonds do not fully mature until 20 years. On a newly organized company, these promissory notes would carry an interest rate of ½ of 1% per annum above the existing prime rate. If a seasoned company applies for money, the loan might carry only prime rate. This type of loan is made attractive at this rate only by account balances and other banking considerations, such as trusteeship under bond indentures, sinking fund account, and transfer agency for stock.

Another type of bank loan to a gas transmission company would be an interim construction loan to be repaid later by the sale of additional common and preferred stock. If a company had only recently placed a new issue of stock, the importance of timing might make it advantageous to place an interim construction loan rather than go back to the public so soon. Maturity on this type of note would probably not be in excess of six months.

Still another type of bank loan would be the establishment of a revolving credit fund for additional construction loans and other short term requirements. As the increased demand for natural gas requires the looping of existing transmission lines, these costs could be met by the revolving credit fund. This revolving credit fund might be set up for a term of two years and be finally amortized by a later stock issue, or by company earnings, or merely renewed if performance was satisfactory at the end of two years. Similarly, a credit agreement could be drawn for the acquisition of property over a period of five years with amortization provided for serially, whether out of earnings or by sale of additional stock or bonds. Another bank loan possibility would be a loan against anticipated depreciation, or undistributed earnings, or other internal sources.

As the source of investments, banks also participate in the purchase of bonds and preferred stocks of the gas transmission companies.

Loans to gas distribution companies

Banks can be of particular assistance to local distribution companies in providing short-term lending for working and fixed capital purposes against the earnings of the company. The local bank is in a better position to evaluate properly earning position of the distribution company, the local need for expanding facilities, and the long range growth possibility of the distribution company. Furthermore, the bank can organize and front the placement of long term debt for expansion of facilities and funding of short term debt. A typical example for this type of operation was Republic's arrangement of an $85 million loan to the Lone Star Gas Co. of which banks carried $20 million and an insurance company carried $65 million. The bank loans were payable over a period of 10 years in semi-annual installments; the insurance company loan was payable over 25 years with no amortization of principal until the bank loan was retired in 10 years.

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Instability of gas contracts, particularly where the escalation must be reviewed each year over a 20-year period and be subject to the whims of Federal Power Commission approval, curtails extension of credit in that proportion that escalation is representative of future net revenue.

For example, our bank is currently making a loan commitment as part of a purchase of gas property. A special provision is written into the loan agreement that our loan is a specific sum if the new gas contract is allowed to begin at the stated price, and further provides that if a lower price is set by the FPC, our loan commitment will be directly reduced in proportion to the reduction in price ordered by the commission. Furthermore, that additional loan value which could be set up against future net revenue represented by the escalation provision cannot be allowed because of the possibility that the FPC will not recognize the equity in allowing the contract escalations schedule. In addition, bankers have shown a general aloofness toward a gas loan where the gas goes interstate on the general theory that the FPC can possibly change the contract at any time by arbitrary decree, and thus vitiate the credit which secures the loan.

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Provided that gas producers are freed from the strangulation of federal regulation, the gas industry can look forward to continued rapid growth. The demand for gas as an industrial and heating fuel in all population centers is practically insatiable. While industrial users still take the greater share of natural gas produced, residential use accounts for the greatest source of revenue. In 1954, residential use accounted for 58% of the revenue received from natural and mixed gas utilities.

The natural gas industry is the sixth largest industry in the United States. Rapid growth continues as the natural gas transmission and distributing companies plan annual spending of $1.1 billion for the next three years.

To keep pace with this growth, banks will increase their financing of gas producers and gas purchasers—an increasing percentage of all petroleum financing will go into gas. Specialized bank financing of gas transportation and utility companies will become even more important after initial debt issues are placed, as was evidenced this past summer. We hope to continue pioneering in this specialized phase of banking that has been so mutually profitable to our bank and to our oil and gas customers. ■

Gas dries coated paper and saves $20,000 yearly

By H. E. RUSSELL
Cincinnati (Ohio) Gas & Electric Co.

DRYING of coated printing papers, used in the high quality graphic arts industry, is a very critical operation. The correct temperature must be maintained at all times to insure uniform drying over the entire surface of the paper. This is an absolute necessity in order to provide the optimum printing surface.

The most widely used method for drying this coating has been by hot air from a steam coil heat exchanger, steam being supplied by a central steam plant.

As part of a recent overall equipment and procedures modernization program at Miami Valley Coated Paper Co., Franklin, Ohio, it was decided to convert to gas heat wherever practical for all plant processing and space heating. The first and most notable changeover in this program was the switch from steam to gas heat for drying the paper coating.

Three direct gas-fired air heaters were installed directly adjacent to the battery of four drying tunnels and connected to them by common ducts crossing over and along the bottom of the tunnels *(Fig. 1)*. With two air heaters on one side and one on the other, all four tunnels are now fed uniformly heated air through two separate recirculating systems. The accumulated output of all three air heaters is about 185,000 cfm at 150°F.

These air heaters are of the scroll-type design and were built by Surface Combustion Corp., Toledo, Ohio. They are standard-rated, package units that operate on low-pressure natural gas and combustion air at 1-lb pressure, from air compressors. They are also operated "push through" in this tunnel drying system, with the recirculating fan discharging into the heater inlet.

The heated air outlet in each of these scroll-type air heaters is located in the center of the casing and discharges horizontally at right angles to the inlet *(Fig. 2)*. When incorporated with a scroll-type circulating fan, this type of design requires less space for the same output compared to the conventional design of air heater.

To insure accurate control of temperature, a control thermocouple is located a short distance downstream from the burner and outlet of each air heater. The control temperature is usually held at about 185° F, but can be varied as required by production. This setup provides exceptionally close control of temperature, which is the prime factor in product quality control. To change the control temperature, within a fairly wide range, only a simple adjustment to the control instrument is required.

Overall operation of the air heaters is simple. After starting up by merely pushing a button they require no further attention, and desired control temperatures are readily obtained and accurately maintained by simple adjustment. With the old steam system, considerable time was required to build up pressure after starting up, and any changes in desired temperature were achieved by lowering or raising this pressure, a very inefficient method.

Operation of the air heaters is safeguarded by the use of electric ignition and a constant burning pilot on the burners. Automatic safeguard units also protect the heating equipment and the entire system against fire and explosion hazards through inadvertent utility failures in the air heaters.

By replacing the steam method with gas heat, two 250-hp boilers were eliminated along with maintenance, fuel storage, floor space, and other added problems. The result has been a yearly savings of $20,000 plus the added advantage of better working conditions, increased production and better control of product. ■

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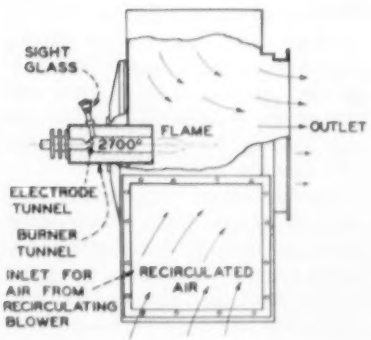

Fig. 2. Cross section of scroll-type air heater showing arrangement of components. The inlet connection is tangential to the casing outer contour. The outlet, in the center, discharges horizontally at right angles to the inlet.

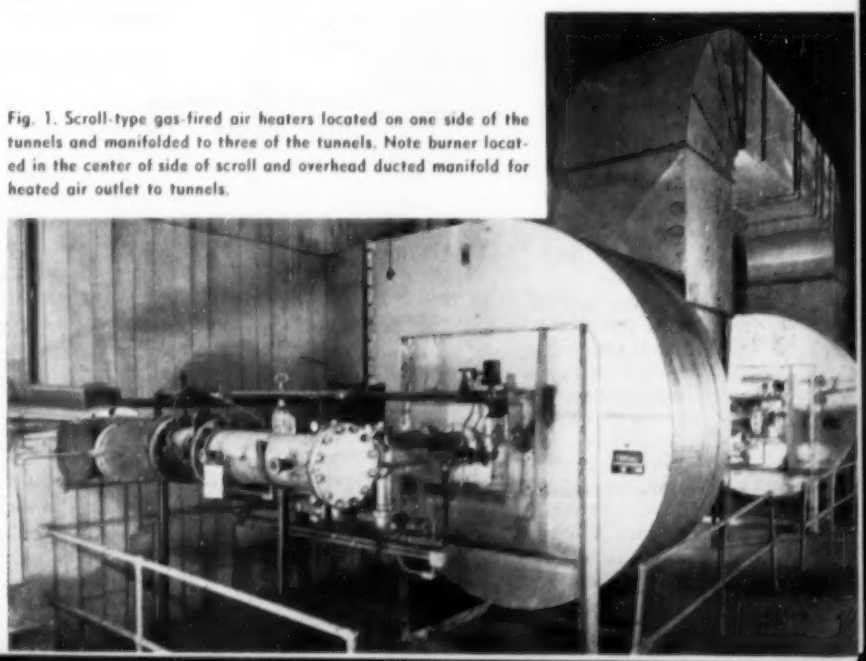

Fig. 1. Scroll-type gas-fired air heaters located on one side of the tunnels and manifolded to three of the tunnels. Note burner located in the center of side of scroll and overhead ducted manifold for heated air outlet to tunnels.

when a new security is issued, the bank loan agreement, usually involving unsecured promissory notes of the company, obligates the company to specific performance in terms of raising money by sale of stock and restricts the company from dilution of assets and ownership, payment of unwarranted dividends, and additional indebtedness. These first maturities are thus indirectly secured by assets through the loan agreement and the maturity is usually limited to a maximum of five or six years, whereas, the first mortgage pipeline bonds do not fully mature until 20 years. On a newly organized company, these promissory notes would carry an interest rate of ½ of 1% per annum above the existing prime rate. If a seasoned company applies for money, the loan might carry only prime rate. This type of loan is made attractive at this rate only by account balances and other banking considerations, such as trusteeship under bond indentures, sinking fund account, and transfer agency for stock.

Another type of bank loan to a gas transmission company would be an interim construction loan to be repaid later by the sale of additional common and preferred stock. If a company had only recently placed a new issue of stock, the importance of timing might make it advantageous to place an interim construction loan rather than go back to the public so soon. Maturity on this type of note would probably not be in excess of six months.

Still another type of bank loan would be the establishment of a revolving credit fund for additional construction loans and other short term requirements. As the increased demand for natural gas requires the looping of existing transmission lines, these costs could be met by the revolving credit fund. This revolving credit fund might be set up for a term of two years and be finally amortized by a later stock issue, or by company earnings, or merely renewed if performance was satisfactory at the end of two years. Similarly, a credit agreement could be drawn for the acquisition of property over a period of five years with amortization provided for serially, whether out of earnings or by sale of additional stock or bonds. Another bank loan possibility would be a loan against anticipated depreciation, or undistributed earnings, or other internal sources.

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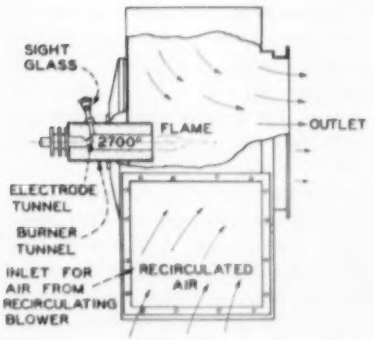

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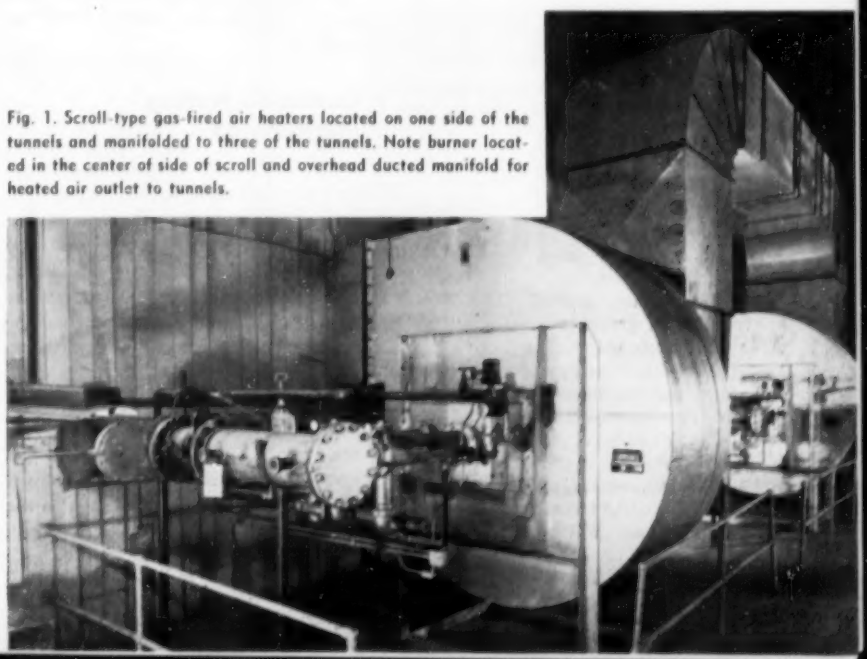

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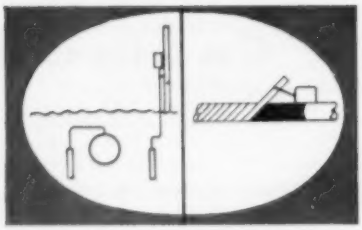
Corrosion Prevention

DISTRIBUTION • TRANSMISSION



By GUY CORFIELD

Training Corrosion engineers

In the January 1956 issue of this page the functions of a corrosion engineer were discussed and it was mentioned that he should have an adequate number of competent and properly trained assistants, and the question has been asked, where do we get these corrosion engineers and assistants? The answer, at least in a large organization, seems to be to train them within the organization, through a carefully developed program of desk and field education.

An interesting discussion of this was given by W. J. Kretschmer of Columbia Gas System Service Corp., Columbus, Ohio, in a paper entitled "Orientation of a Corrosion Control Program" to the AGA corrosion conference in April 1954. This paper outlines the training procedures currently used by the service corporation and its numerous affiliates to develop both corrosion engineers and technicians to fill the many corrosion control positions both in staff and in the many operating companies and departments. All the details are too lengthy for inclusion here, but the training given a junior engineer when he is assigned to the corrosion section of the gas engineering department is as follows:

A. Engineering—office
   1. Education
      a. Study of the theory of corrosion and control.
      b. Review of system practices and procedures.
   2. Engineering—general
      Design, development, testing (laboratory and field), etc.
      Estimated time in training . . *6 weeks*

B. Operating functions—field
   1. Corrosion surveys
      a. Soil surveys . . . . . *1 week*
      b. Potential and current
         Requirements surveys (cathodic protection preliminary design survey and final operating surveys including interference tests) . . . . . *2 weeks*
      c. Stray current surveys (preliminary drainage design, and final check surveys including interference control) . . . . . *2 weeks*
   2. Cathodic protection, electrolysis installation
      a. Supervise the installation of cathodic protection of line by rectifiers and/or magnesium anodes on company or contract jobs *1 week*
      b. Supervise the installation of electrolysis drainage system . *1 week*
      (Both items above under supervision of operating company corrosion engineer.)
   3. Pipeline construction
      a. Coating inspection (duties subordinate to operating company chief coating inspector) . . . . . *3 weeks*
      Total approximate time all functions . . . . . *16 weeks*

It is stated in the conclusion of Mr. Kretschmer's paper that "To make any corrosion control program efficient and effective there must be an adequate training program established, a coordinated engineering and mechanical organization existing, and sincere cooperation between management and those responsible for the fulfillment of the program."

Corrosion testing instruments

In 1951 the AGA corrosion committee's subcommittee on instrumentation prepared a "Reference Book on Instruments for Electrolysis, Corrosion and Cathodic Protection Testing," offered as a collection of information relative to instruments and equipment for these types of testing, and divided into two main sections.

The first section, of 48 pages, was a text comprised of articles written with the intention of simplifying technical knowledge so that it would comply with the practical needs of men in the field.

In general, the articles pertained to basic theory, characteristics and use of the various instruments and equipment used in electrolysis, corrosion and cathodic protection testing, to indicate what instrument to use for the various types of measurements commonly encountered.

The second section contained catalog sheets and descriptive circulars supplied by instrument manufacturers, grouped in sections according to the types of instruments, i.e., voltmeters, ammeters, combination testing sets, earth-resistivity meters, pH meters, pipe locators, holiday detectors, reference electrodes, etc. An attempt was made to contact all manufacturers of applicable instruments and to keep the material up to date as new manufacturers and instruments entered the field.

This reference book has been a valuable aid to corrosion engineers not only as a basic text, but also in keeping them aware of the various instruments available on the market with detail as to function, source and price. Anyone purchasing the book has been kept on the mailing list and automatically furnished with new material free of charge by AGA as such material comes to the attention of the subcommittee and the secretary of the operating section. Copies are still available at AGA Headquarters, at a cost of $1.50. They contain all the material used to date and will likewise be supplemented with data available in the future.

Another source of information on instruments is the very complete paper, under the title of "A Survey of Corrosion Control Instruments," prepared for the AGA corrosion conference in April 1954 by Francis W. Ringer, consulting engineer, 7 Hampden Ave., Narberth, Pa. The extensive data listed in this paper "was obtained by correspondence with all known manufacturers and distributors of instruments applicable to corrosion control work."

...with these 2 great new

Servel products!

Servel has pioneered in the field of residential and industrial cooling with gas. And now, Servel introduces two new products to help you sell more gas during your summer slump.

You can help Servel help you—by promoting these and other Servel products in your area. Write today for complete information about Servel air conditioning, advertising and sales promotion. SERVEL, INC., Dept. G36, Evansville 20, Indiana

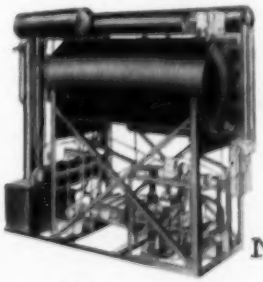
Servel the name to watch for great advances in

AIR CONDITIONING ✓ REFRIGERATION

NEW

3-ton All-Year® Unit

This amazing new model puts air conditioning within the reach of more of your customers. Simplified design, easier installation, and space-saving size actually save hundreds of dollars.



NEW

25-ton Water Chiller

Here, for the first time is a water chiller with *all operating and safety controls built in*. Saves a customer real money because it is simpler and faster to install—three simple connections.

Also manufacturers of the famous Servel "Ice-Magic" Gas Refrigerator

GAS people

Promotions

Lone Star Gas Co., Dallas, has announced several changes. J. M. LYNN JR. has been named assistant sales and promotion manager for the general division of distribution succeeding CARL L. TREVITT, who is retiring. JOHN PERRYMAN succeeds Mr. Lynn as sales promotion manager for the Dallas division of distribution, while B. T. MURDAUGH succeeds Mr. Perryman as regional sales and promotion manager for the distribution properties in west Texas. KENNETH N. WATKINS has been appointed manager of the dealer assistance section in the general sales and promotion department of the general division.

ELLSWORTH B. CARPENTER, vice president/sales of American Car & Foundry division of ACF Industries Inc., has been named to supervise and direct sales in the eastern region of the U. S. JOHN E. ANGST, also a vice president/sales, will supervise and direct sales for the western region. J. R. PETERSON is now manager, market research.

VERNON M. F. TALLMAN, who has been consulting engineer with Brockton (Mass.) Taunton Gas Co. for many years, has been elected a vice president to succeed FRANK S. CLIFFORD, who has retired after 53 years of service. Mr. Clifford continues as director.

V. M. Tallman
Brockton

A. C. Daugherty
Rockwell

A. CLARK DAUGHERTY, former market research manager of Rockwell Manufacturing Co., Pittsburgh, has been named assistant to the president. The market research, public relations and stockholder information departments will continue to report to him.

The company has also named EARL HUDSON, assistant general manager of the gas meter plant at DuBois, Pa., to the post of general manager of its new meter and valve plant at Porterville, Calif.

Bucyrus-Erie Co., South Milwaukee, has promoted SELDEN A. STONE to well drill sales manager. L. B. BIRCHHEAD, former drill sales manager, will serve in an advisory capacity in connection with spudder sales.

ARTHUR H. CHENEY has been named rate and research engineer for Central Vermont Public Service Corp., Rutland.

M. R. GILBERT JR., who has been serving as sales representative in the cooking appliances controls division, has been named district manager of the heating controls of Robertshaw-Fulton Controls Co. in the Chicago area.

WILLIAM S. VAUGHN has been elected president and director of Eastman Chemical Products Inc. Mr. Vaughan, formerly 1st vice president, succeeds JAMES C. WHITE, who becomes chairman of the board.

NORMAN E. HATHAWAY, who has been western sales manager, has been promoted to coordinator of marketing for Oronite Chemical Co., San Francisco. Three new regional sales managers have been named: W. M. BURGE will head up the midwestern region with headquarters in Chicago, J. R.

Take a close look at the engineering and construction features of the Lancaster Groove Type Metal Rim Diaphragm and you'll see why it assures greater over-all accuracy and more years of service in the meter.

New—BETTER SEALING

Now Lancaster offers better sealing with the new Lancaster Buna-N-Cork Meter Gaskets. Here's the answer to that occasional gasket leakage. Send for a sample today and test it in your shop.

Lancaster METER PARTS CO.

POST OFFICE BOX 378 LANCASTER, OHIO

Your *Caloric* "Selling Spree" begins at HOME

Beginning in March, the fabulous NBC-TV network show "Home" will pre-sell Caloric gas ranges to millions of interested housewives

13 attention-getting wallops, delivered by Caloric on coast-to-coast TV! Millions of customers will hear and see the Caloric story in their own homes. It's the nearest thing to a personal demonstration right on your own floor. Here's an advertising campaign that offers world-beating merchandising opportunities.

Be Sure to Tie In—Use Your Own Local Advertising

This 16-cylinder advertising program will capitalize on the tremendous interest created in Caloric Ranges by "HOME" last fall. But remember, this plus business . . . a big chunk of it right in your home town . . . should be backed up by your own local advertising and display support. Your Caloric salesman is on his way with all the tie-in promotional material you need to make your Caloric "Selling Spree" a success!

More "Selling Spree" News!

"HOME" is initiating a nationwide promotion called "The House that Home Built." It's an actual house, designed as an ultra-modern showcase for all that's new in today's living. NBC is making it the center of a tremendous publicity barrage to its television audience. Naturally, in the kitchen is a Caloric Built-in gas range. It all helps to make 1956 the biggest Caloric year ever!

Your "Selling Spree" Promotion Kit Includes . . .

window-streamers, point-of-sale easels, advertising mats, radio scripts, reprints, TV films, stickers, window displays, car cards, billboards, mailers.

Caloric Appliance Corporation • Topton, Pa.

RANGES • DRYERS • BUILT-INS • DISPOSERS

Caloric Appliance Corporation
Dept. G
Topton, Pa.

Please send me information I need to tie in with the Caloric "Selling Spree" on NBC's Network TV show, "HOME".

Name_____

Address_____

City_____ Zone_____ State_____

STITT is eastern manager with headquarters in New York, and T. M. WELTON is the new western regional sales manager, San Francisco.

Three officers of Arkansas Louisiana Gas Co. were elected recently. JOE C. HARDIN is vice president in charge of Arkansas operations; F. L. HOLLEMAN is secretary-treasurer; and H. G. WALTERS is assistant secretary-treasurer.

ALWIN B. NEWTON, Coleman Co. chief design engineer and member of the board of directors, has been named vice president in charge of all phases of the company's design and research activities. He succeeds BOYD W. TULLIS, who retired Dec. 31. Mr. Tullis will remain with the company as special assistant to the president and as a member of the board of directors and executive committee.

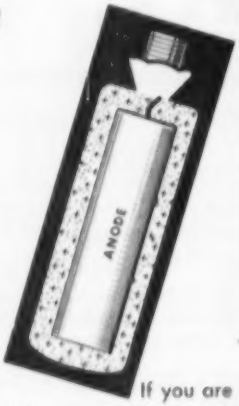
Columbia Gas System Inc. has elected CHARLES H. MANN treasurer and KARL SHAVER assistant secretary. Mr. Mann, who is also treasurer of the Columbia Gas System Service Corp., succeeds FRANCIS H. CRISSMAN, who recently was promoted to vice president and chief financial officer.

VIBRA PAK

Standard Magnesium VIBRA-PAK ANODES *are uniformly packed which permits evenly distributed electrolytic action over the whole surface of the anode.*

This even distribution means longer lasting, higher operating efficiency. Gives added protection against corrosion loss.

Next time specify VIBRA-PAK.



*PAT. APPLIED FOR

If you are faced with a corrosion problem, let our engineers help you solve it. There's no obligation, of course. Wire, write or phone today.

Standard Magnesium Corporation

P. O. BOX 1424G • TULSA, OKLAHOMA

H. L. Masser

R. I. Snyder

SoCal

HARRY L. MASSER, executive vice president of Southern California Gas Co., Los Angeles, has retired after nearly 40 years of service. A former president of the PCGA, Mr. Masser first joined SoCal in 1915, leaving for military service and later a position with the PUC. In 1924 he returned to the gas business as gas engineer for the Los Angeles Gas & Electric Corp., becoming vice president and director in 1928 and assistant general manager in 1932. In 1937 when Los Angeles Gas merged with SoCal, he was elected executive vice president.

SoCal has also announced the election of R. I. SNYDER as vice president. Mr. Snyder, formerly manager of the distribution department, was named vice president last September to serve as a general assistant to Mr. Masser. He will direct customer service and distribution department activities.

N. C. MCGOWEN, president of United Gas Corp., Shreveport, has been elected chairman of the board. Mr. McGowen, who will continue as president of UGC, has also been elected chairman of the board of two subsidiaries, United Gas Pipe Line Co. and Union Producing Co. As chairman of all three companies, Mr. McGowen, with 41 years' experience with the corporation and predecessor companies, will continue to serve as chief executive officer of the concern and its subsidiaries.

N. C. McGowen
United Gas

K. W. Reece
Ebasco

Ebasco Services Inc., New York, has announced several promotions. K. W. REECE, who has been vice president in charge of engineering and construc-

tion, is now executive vice president; vice president in charge of construction is E. K. WILKINS; W. H. COLQUHOUN is vice president in charge of engineering; and ALBERT W. SMITH is now assistant manager of the sales, marketing and public relations consulting department.

A. J. Herrmann

J. W. MacKay

American Cast Iron

American Cast Iron Pipe Co., Birmingham, Ala., has elected ARNOLD J. HERRMANN executive vice president. Mr. Herrmann, a veteran of 41 years continuous service with Acipco, has been secretary and vice president in charge of sales. The company has also elected J. W. MACKAY as vice president, sales manager and secretary. JAMES B. HILL is now assistant sales manager and PAUL W. GREEN has been made manager of the Kansas City sales office, succeeding Mr. Hill.

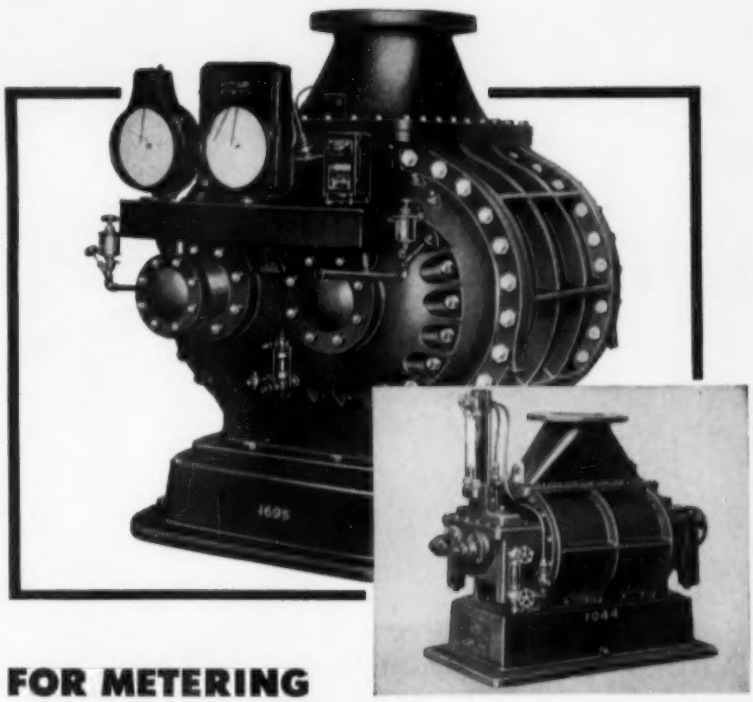
New district managers for the New Haven, Conn., and Minneapolis, Minn., territories of Servel Inc. are EDWARD H. NEUBAUER and RICHARD J. ROZA, respectively.

RANDALL P. SAXTON, formerly superintendent of the gas department of Housatonic Public Service Co., Derby, Conn., has been promoted to the newly created position of vice president.

Two new vice presidents have been elected by Philadelphia (Pa.) Electric Co. H. N. RAMSEY is executive vice president of the company and W. H. JONES is vice president in charge of purchasing and service operations. Mr. Ramsey was also elected a director.

ALAN A. CULLMAN and LORING E. HECKMAN have been elected vice presidents of Columbia Gas System Service Corp. Mr. Cullman will be in charge of economic research while Mr. Heckman will be in charge of operations and planning.

DAVID D. GORDON has been promoted to sales manager of the Fulton Sylphon division, Robertshaw-Fulton Controls Co., for the Los Angeles district, succeeding W. J. HAJEK, who has transferred to the Chicago office.



FOR METERING

5,000 cfh or a MILLION

R-C *plur-ability*

PAYS DIVIDENDS

Look for R-C plur-ability in all your equipment to handle gas and air

Centrifugal and Rotary Positive Blowers, Gas Pumps and Exhausters

• • •

Spiraxial® Compressors

• • •

Positive Displacement Vacuum Pumps and Meters

• • •

Inert Gas Generators

• • •

Ask for detailed bulletins on any R-C product—or write us your needs.

Packed into every Roots-Connersville Positive Displacement Gas Meter are important values which mean *"plur-ability."* Summed up, they give you accuracy unmatched by any other type—that endures over many years of use. Maintenance is practically unknown, with no vanes, valves, or small parts. Compactness saves space and foundation cost. Capacities, pressures and overload ability fit your most exacting needs. Wherever you need to measure gas from 5,000 cfh to a million, you can trust the staying qualities of R-C Positive Displacement Meters. Ask for specification details in Bulletin M-152.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

356 Oregon Ave., Connersville, Indiana. In Canada — 629 Adelaide St. W., Toronto, Ont.

now... A complete line of
HOT NORMAL WARM
UNITROL 200
ROBERTSHAW GRAYSON
MODEL 200
Robertshaw-Grayson thermocouples and pilots belong together — because they are designed to work together.
Air-gap construction throughout prevents water entering gas lines.
HOT NORMAL WARM
UNITROL 400
ROBERTSHAW GRAYSON
MODEL 400

standardized controls

Now, for the first time, a complete line of water heater controls standardized to cut your costs. Water heaters are big business and accessories, too, should be handled in a big business way. That's why standardization plays such a big part in the new Unitrol line. All have 100% shut off. All adjustments are readily accessible from the front. Many parts are interchangeable such as magnet assemblies, filters and valves. These controls are also interchangeable for standardization of manifold piping – all of which add up to reduced inventories, standard servicing and reduction in engineering time.

MODEL 110

Robertshaw®-Grayson®

UNITROL®

America's most beautiful water heater controls **BY WORLD'S LARGEST MANUFACTURER**

MR. CONTROLS®

Robertshaw-Fulton CONTROLS COMPANY

Grayson Controls Division, Long Beach, California

Robertshaw-Fulton Controls Company (Canada) Ltd., Toronto

Robertshaw-Fulton Controls (Australia) Pty. Limited, Burwood, N.S.W.

SELECT THE CONTROLS THAT HELP YOU SELL

people • *Continued*

RICHARD BEAUBIEN, formerly sales engineer in the commercial division in Los Angeles, has been named branch commercial division sales manager for the San Francisco office of Minneapolis-Honeywell Regulator Co.

JACKSON C. HINDS JR. has been elected vice president and general counsel of Houston (Texas) Natural Gas Corp. Mr. Hinds, who has served as a consultant in the firm's legal affairs since 1932, will head a newly organized legal department.

New faces

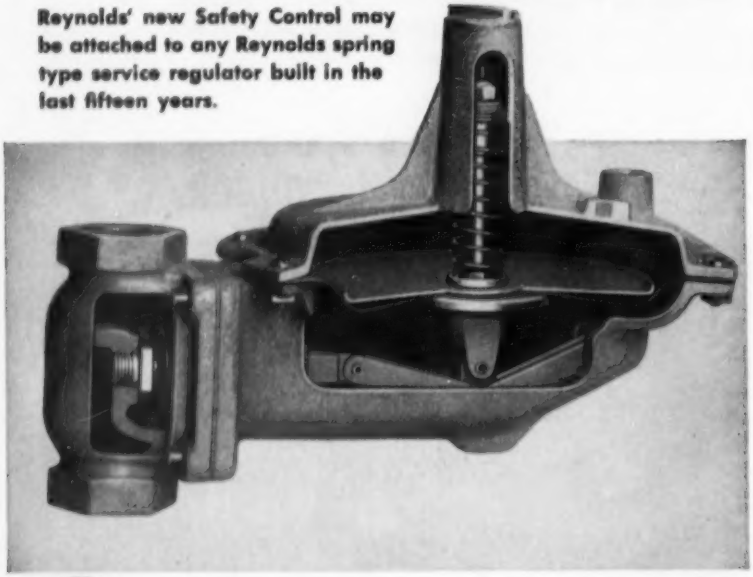
EDWARD M. ROCHE has joined Beacon Petroleum Co., Tulsa, as manager of supply and distribution. He will be responsible for moving schedules of all products to the proper markets.

WILLIAM L. MAYO has joined Thermac Co., Los Angeles, as sales engineer in the midwestern and midcontinent area. He will headquarter in St. Louis.

JACK D. SCHWARTZ has joined Washington Natural Gas Co. as assistant director of public relations.

Reynolds OFFERS A NEW PERFECTED SAFETY CONTROL FOR ALL SERVICE REGULATORS

Reynolds' new Safety Control may be attached to any Reynolds spring type service regulator built in the last fifteen years.



GAS CONTROL SINCE 1892

* **Prevent regulator from falling in a wide open position, thus limiting the amount of gas the safety seal has to pass.**
* **Enable the gas company to set the regulator for a certain demand and if a customer increases that, his outlet pressure would drop which would cause him to call the company and they can find out what his real demands are.**

REYNOLDS GAS REGULATOR CO.
ANDERSON, INDIANA

DR. ALBERT J. BLAIR has joined the Consolidated Natural Gas Co. as assistant medical director. He will have his offices at the Pittsburgh headquarters of Peoples Natural Gas Co. and New York State Natural Gas Corp., two Consolidated subsidiaries.

WILLIAM F. KELLY, president and director of the First Pennsylvania Banking & Trust Co., Philadelphia, has been elected a director of Peoples Water & Gas Co., Miami, Fla.

DAVID J. FRAADE has joined Consolidated Electrodynamics Corp., Pasadena, Calif., as a sales specialist in the field of process-control instuments.

JOHN ERNST has joined Ruud Manufacturing Co., Kalamazoo, Mich., as factory sales representative in northern Ohio.

Honors

D. A. HULCY, president of Lone Star Gas Co., has been reelected president of the Dallas Citizens Council.

HOWARD B. NOYES, vice president of Washington (D. C.) Gas Light Co., has been honored by the American Standards Association in recognition of his work in the development of American Standards. His citation read "The . . . association presents this certificate in recognition of contributions to the establishment of voluntary standards and in appreciation of sound advice and devotion of energy to the furtherance of the standards movement as a means of advancing the national economy."

Deaths

DON C. NICOL, manager of the New York City office of Ruud Manufacturing Co., died recently at his home in Chatham, N. J. Before joining Ruud six years ago, Mr. Nicol had been with John Wood Manufacturing Co. for 22 years.

E. D. WARREN, 58, field superintendent of pipelines for Natural Gas Pipeline Co. of America, died recently in Beatrice, Neb. Mr. Warren, who celebrated his 25th anniversary with the company in June, 1955, had served as superintendent of pipeline construction and division superintendent of pipelines before he became field superintendent in 1947.

ERNEST C. HATHAWAY, 60, director of industrial development for Central Vermont Public Service Corp. died recently in Rutland. He served for more than 31 years with Central Vermont.

GAS news

New highway bill has reimbursement clause

A reimbursement clause for relocation of facilities has been incorporated in a new highway bill introduced in the House by Rep. Fallon (D.-Md.). The bill calls for some $36 billion of federal highway spending over the next 13 years.

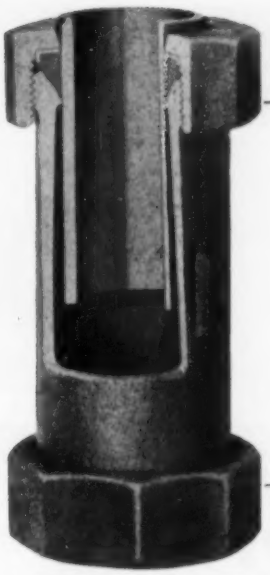
Whenever a state shall pay for the cost of relocation of utility facilities in connection with federal-aid highway construction, the bill says "federal funds may be used to reimburse the state for such cost in the same proportion as federal funds are expended on the project." A provision under which up to 50% of such costs could be paid from federal funds in states where utilities now shoulder all relocation costs was contained in last year's Senate-passed Gore bill.

West Virginia to offer corrosion short course

The first annual Appalachian underground corrosion short course, sponsored by the School of Mines of West Virginia University, will be held June 11-13 on the campus at Morgantown, W. Va.

Thirty-four representatives of major companies having underground structures met late last year in Morgantown and organized the school for the purpose of providing an opportunity for persons concerned with underground corrosion to obtain information and acquaint themselves with the principles and latest developments in the field of corrosion mitigation.

Heads of committees are as follows: Frank E. Costanzo, Manufacturers Light & Heat Co., general; C. M. Rutter, Equitable Gas Co., rules; C. A. Erickson, Peoples Natural Gas Co., program; Charles L. Dey, Koppers Co. Inc., vice chairman; W. J. Kretschmer, Columbia Gas System Service Corp., publications; Percy L. Knott, Dearborn Chemical Co., and Robert H. Edele, West University, exhibits; William R. Curley, Stuart Steel Protection Corp., publicity. R. E.



NORMAC

Couplings, Sleeves and Fittings

for maximum deflection, ease of "stabbing," complete confinement of the rubber!

So close are "Normac" rubbers confined at the gasket tip that possibility of flow is reduced almost to "nil." These couplings, sleeves and fittings . . . approved by gas utility men across the country for their time-saving features, ease of handling and dependable service . . . are available in a complete range of sizes. Made from air furnace malleable iron they provide greater wall thickness than pipe on which used.

NORMAC COUPLINGS are made with 5" centers in all sizes. NORMAC SLEEVES are identical in design except that they are made with 10" centers. Nuts and gaskets are interchangeable.

Compression-End Service "Tee"—First fitting of this type ever produced with full coupling depth and special threads on male end to prevent dropping into old hand taps when used to replace standard threaded fittings.

Compression-End Service "Ell" — Extra depth makes it possible to "stab" pipe into stops and without measuring, pull back a safe distance to allow ultimate deflection eliminating possibility of strain against tap in main.

Compression-End Iron Body Brass Core Service Stopcocks—End the necessity of threading on the job plus the elimination of the threads themselves—combining all the advantages of NORMAC COUPLINGS and the best in stopcock design. 2½" coupling depth on each end.

Normac Brass Fittings Developed in 1939 for Use with Copper Tubing—Our complete line of brass fittings can be used either on new installations or where copper is run through old steel pipe in large or small openings. The center to end dimensions of NORMAC TEES correspond with old malleable iron fittings. This feature is extremely important in the use of these fittings in one foot openings where the tubing must line up with the steel which has been removed.

Write for the NORMAC CATALOG of Gas Distribution Equipment

NORTON-McMURRAY MFG. CO.

122 SOUTH MICHIGAN AVENUE - - - CHICAGO 3, ILLINOIS

Couplings • Meter Bars • Sleeves • Cocks • Bell Joint Clamps • Service Tees & Ells

Hanna Jr. of the university is in charge of registration and is secretary-treasurer of the organization.

Corrosion prevention, corrosion testing, cathodic protection, coatings, design, stray current, and special topics will be covered.

PG&E delivers gas to more California communities

With the completion of a new high-pressure, 60-mile line from Kramer's Corner, near the Kern-San Bernardino county border, through the towns of Red Mountain, Westend, Borosolvay, Argus, and Trona to Pioneer Point, Pacific Gas & Electric Co. has inaugurated gas service to the growing Searles valley region of northwestern San Bernardino county.

Construction of the line, which gets its gas from the Super Inch line, presented some obstacles, including steep grades, some as high as 35%, and rocky ground. Pipe and other materials were moved up the inclines with tractors, and pull shovels and dynamite were employed where the ground was too rocky for trenchers.

Two large-volume customers — American Potash and Chemical Co. at Trona and West End Chemical Co. at Westend—make it possible to bring firm, low-cost gas service to homes, stores, and other customers along the route.

On display at the recent Chicago appliance mart were the latest model gas ranges offering many innovations. Among these is a "roast guide," held here by Bob Scheifer (kneeling) of Magic Chef. The roast guide plugs into the meat and registers when it has reached the rare, medium or well-done stage on the back splash. Gard Huff of Reps Furniture Co., Parkersburg, W. Va., looks on.

STOP
Corrosion
on
• GAS DISTRIBUTION SYSTEMS
• WATER LINES
• UNDERGROUND CABLES
• STORAGE TANKS
AN-SPEC
MAGNESIUM ANODES
Gas or water line leaks due to corrosion are expensive profit eaters in both repair time and replacement costs. An-Spec magnesium anodes protect your underground or submerged metal structures from industries most costly enemy—CORROSION. Call us for high quality magnesium anodes . . . experienced installation crews . . . competent engineering . . .
PIPE LINE ANODE
CORPORATION
23th WEST AVENUE AND SAND SPRINGS ROAD
P. O. BOX 996 ● TULSA, OKLAHOMA
WRITE FOR FREE BROCHURE
NAME
ADDRESS
CITY & STATE
ANODE SPECIALISTS
AN-SPEC

Elliott succeeds Pettyjohn as director of IGT

Martin Elliott

New director of the Institute of Gas Technology is Dr. Martin A. Elliott, who has been a professional staff member of Illinois Tech's mechanical engineering department since 1952. He succeeds Capt. E. S. Pettyjohn, who resigned recently.

Dr. Elliott assumed the directorship of the institute on Feb. 1. From 1934 to 1938, he was assistant to the super-

Visible proof of the constant temperature that can be maintained on the Caloric built-in range thermostatic top burner control is seen by Leland White (right) of White Furnace Co., Plainview, Texas, while Marshall W. Batchelder, manager of Caloric's metropolitan Chicago division, gives the right slant to the reading.

intendent of the Baltimore (Md.) gas utility, and from 1938 until 1952 he was associated with the U. S. Bureau of Mines in Pittsburgh, where he served, successively, as the principal chemical engineer, assistant chief of the explosives division, and chief of synthetic liquid fuels research.

A research engineer at Illinois Institute of Technology, Dr. Elliott received bachelor and doctor of philosophy degrees in gas engineering from Johns Hopkins University.

Ark-La considering petrochemical plant

Plans for the construction of a multimillion-dollar plant to make petrochemical products in Arkansas are under study by Arkansas Louisiana Gas Co., according to J. C. Hamilton, company president. The plant would cost up to $22.5 million, depending on the type of products it would produce.

At present Ark-La is thinking about the production of butadiene or fuel for jet airplanes. Engineering studies on some phases of the proposed plant have been completed, Mr. Hamilton said.

Large-scale growth marked 1955 for United Gas Corp.

1955 sales of United Gas Corp. again exceeded 1 trillion cu ft, totaling 65 billion cu ft more than in 1954. A new record for natural gas handled in one day was established in December when in a single 24-hr perior deliveries exceeded 4.6 billion cu ft.

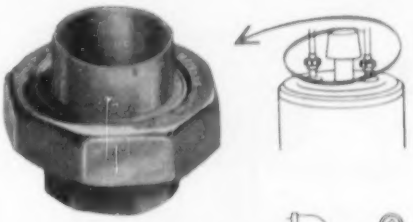
Exploration and development activities, principally in Cherokee county, Texas, and Hancock county, Miss., dur-

PROTECT YOUR PIPE INSTALLATIONS

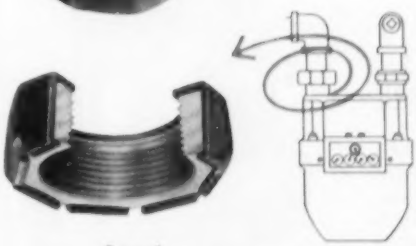
. . . against GALVANIC and ELECTROLYTIC CORROSION

1. Zinc-plated shell thread piece 2. Insulating gasket 3. Zinc or brass threaded tail piece 4. Zinc-plated steel shell with Nylon core

UNIVERSAL Insulated PIPE UNIONS and METER NUTS



Pipe Unions for domestic and industrial installations in ⅛" to 2" pipe sizes. Also reducing types. Used and recommended for water heater tanks and large insulating gas meter applications. Handy chart of type and sizes available.



Meter Nuts have heavy zinc-plated steel shells containing threaded Nylon cores. Threads are machine cut (not molded) for each type and size of meter. Provides positive insulation at minimum cost.

Patented

WRITE FOR DESCRIPTIVE LITERATURE

GAS SERVICE REGULATORS • METER REPAIR AND TEST STANDS • BREATHER VENTS "DRAGNET" LEAK DETECTORS • SINCE 1947

UNIVERSAL CONTROLS CORPORATION

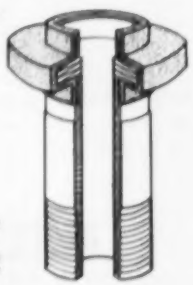
P. O. BOX 13122 • WALNUT HILL STATION • DALLAS 20, TEXAS

NYLON MOLDED INSULATED METER SWIVEL

Use With Standard Nut and Gasket

- NO INSULATED THREADS
- NO INSTALLATION BREAKAGE
- NO "BLIND DISC" FAILURE

Tested and Approved By Many Gas Companies



CENTRAL PLASTICS COMPANY

P. O. Box 762, Shawnee, Okla. • Telephone: 6302

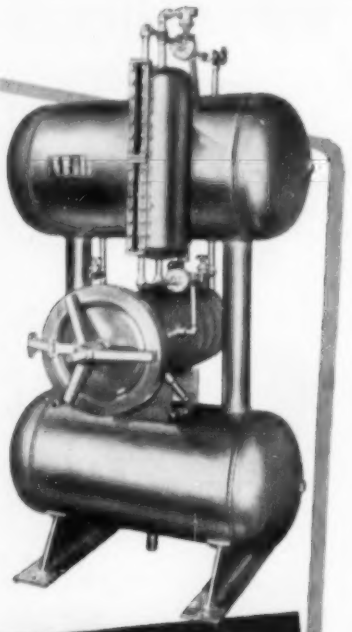
ing the year increased total reserves of natural gas, crude oil and other liquid products. An aggressive policy of lease acquisition resulted in obtaining leases during the year on some 132,000 acres, more than 2600 of which are on the Continental Shelf off the coast of Louisiana. At the end of the year, oil, gas and mineral leases were owned on 1.7 million acres.

A major project started last year is the construction of United's first underground storage field near Jackson, Miss. A substantially depleted gas field is being used for storage purposes and will provide the system with a capacity of 3 billion cu ft of gas.

PG&E employees to see company's own roadshow

Pacific Gas & Electric Co. is "going on the road," expecting to cover 1602 miles in northern and central California with its 1956 road show for PG&E employees, "There's No Business Like Our Business," devoted to the company's program. Fifteen cities in the company's service territory will have one-night stands of the production,

PEERLESS
Type "MP"
ODORIZER UNIT with SILLERS FLEX RING CLOSURE



The Peerless Type "MP" Odorization Unit has been designed to provide a complete odorization setup which is easily installed. This odorizer utilizes the Patented Peerless principle of liquid odorant injection.

LOOK AT THESE ADVANTAGES . . .

- Accurate proportioning of odorant into line.
- Safety tank built in. Cannot flood.
- Leakage is eliminated since all welded piping and packless valves are used.
- It occupies a minimum of space. Only one foundation needed.
- A minimum of piping is required for installation.
- Installation time is reduced.
- Maintaining odorizer is quite simple. Odorizer mechanism easily accessible.
- Positive seal of odorizer housing with Sillers Flex Ring Closure.

Write for Bulletin 904 & 905

Peerless Type "MP" Odorizers have many more outstanding advantages, all engineered to give you the most accurate odorizer available.

PEERLESS MFG. CO.

PEERLESS MANUFACTURING CO.

P O BOX 13165 ★ DALLAS 20, TEXAS ★ Dixon 8431

REPRESENTATIVES IN ALL PRINCIPAL CITIES

GAS calendar

March

1-2..SGA Distribution Management Conference and Transmission Management Conference — Jung Hotel, New Orleans.

12-16..National Association of Corrosion Engineers Annual Meeting — Hotel Statler, New York.

19-21..MidWest Gas Association — Hotel Fontenelle, Omaha.

22-23..New England Gas Association Annual Meeting — Hotel Statler, Boston.

22-23..Oklahoma Utilities Association Annual Convention — Biltmore Hotel, Oklahoma City.

April

3-4..AGA Research & Utilization Conference — Cleveland.

4-6..AGA General Management Section Spring Conference — Conrad Hilton Hotel, Chicago.

9-11..AGA-Practicing Law Institute 2nd Legal Symposium — Waldorf-Astoria Hotel, New York.

13-14..Florida-Georgia Gas Association General Management Conference — Lakeside Inn, Mount Dora, Fla.

14-15..SGA Conference on Electronic Computers — Hilton Hotel, El Paso.

16-18..National Conference of Electric & Gas Utility Accountants — Hotels Biltmore and Commodore, New York City.

16-19..AGA Sales Conference on Industrial & Commercial Gas —Hotel Roanoke, Roanoke, Va.

17-19..Southwestern Gas Measurement Short Course — University of Oklahoma, Norman.

19-20..Indiana Gas Association — French Lick Springs Hotel, French Lick, Ind.

19-21..GAMA Annual Meeting — The Greenbrier, White Sulphur Springs, W. Va.

23-25..Southern Gas Association Annual Convention—Dallas.

23-25..AGA-Midwest Regional Gas Sales Conference — Edgewater Beach Hotel, Chicago.

25-29..World Oil Exposition—Houston, Texas.

May

6-9..LPGA Convention and Trade Show—Conrad Hilton Hotel, Chicago.

7-10..AGA Distribution, Motor Vehicles, and Corrosion Conference—Congress Hotel, Chicago.

7-11..AGA Commercial Gas School — Edgewater Beach Hotel, Chicago.

10-11..AGA Gas Supply, Transmission & Storage Conference—Conrad Hilton Hotel, Chicago.

16-18..AGA Chemical Engineering & Manufactured Gas Production Conference — Philadelphia.

22-24..Pennsylvania Gas Association —Pocono Manor Inn, Pocono Manor, Pa.

24-25..Natural Gas & Petroleum Association of Canada—Sheraton Brock Hotel, Niagara Falls, Ont., Canada.

31-June 1..11th Annual Short Course in Gas Technology—Texas College of Arts and Industries, Kingsville, Texas.

June

4-8..National Fire Protection Association 60th Annual Meeting—Hotel Statler, Boston.

11-13..Appalachian Underground Corrosion Short Course—West Virginia University, Morgantown.

26-29..Canadian Gas Association — Manoir Richelieu, Murray Bay, Quebec.

25-26..Michigan Gas Association—Grand Hotel, Mackinac Island, Mich.

September

11-13..Pacific Coast Gas Association Annual Meeting—Coronado, Calif.

12-14..Mid-West Gas Association Gas School and Conference — Iowa State College, Ames.

12-14..3rd Annual Electrical Conference of the Petroleum Industry (AIEE)—Kansas City, Mo.

October

Week of Oct. 15..AGA Annual Convention—Atlantic City, N. J.

Maintains fast "*work-and-run*" schedule

DRIVES ANYWHERE — *Automotive-type steering and big, hydraulic, truck-type brakes give safe travel over streets and highways. Overall width is only 6 feet.*

BACKFILLS ITS OWN TRENCH — *Equipped with 6-foot blade (optional), Trenchmobile completes the job — with one-man, one-machine economy. Also check Parsons complete line of crawler-mounted Trenchliners®.*

To step up work schedules on all those scattered, small-yardage trenching jobs around town, look into the mobility and big production capacity of Parsons Trenchmobile. It drives cross-town, through traffic at 12.6 m.p.h. — works fast, too. Digs up to 14½ feet of trench per minute, 8 to 16 inches wide, at depths to 5 feet. Gets the job done in a hurry — drives on to next job *right now*. No waiting for trailer—no loading or unloading delays.

You also save a lot of hand clean-up. Trenchmobile undercuts walks, curbs and gutters, existing mains — makes vertical set-ins, flush with buildings and foundation walls. Positive down-crowd boom starts cut fast, holds accurate grade. Shiftable, reversible spoil conveyor dodges trees, hedges, poles, other obstructions. How about a Trenchmobile demonstration on your work? Parsons distributor will gladly arrange it. See him, or write us.

to: **PARSONS COMPANY, Newton, Iowa**
Send bulletin on 43.6 HP Model 88 Trenchmobile.

NAME_____

TITLE_____

COMPANY_____

DIVISION_____

STREET_____

CITY, STATE_____

P674 GAS

PARSONS TRENCHMOBILE®
(Keystone Subsidiary)

✓ locate and classify gas leaks promptly

✓ reduce unaccounted for gas loss and get maximum SAFETY

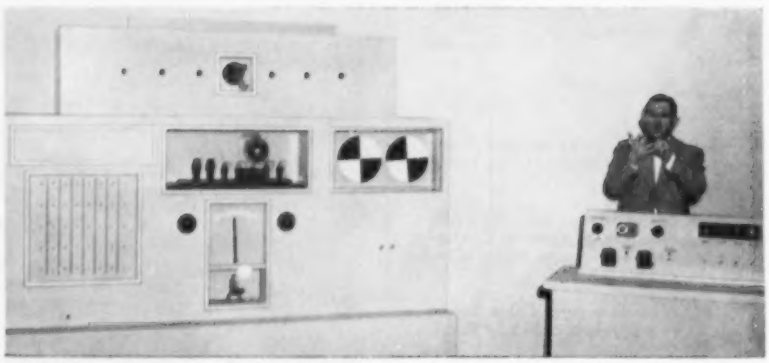
HEATH Leakage Control Surveys

have been used by leading U. S. and Canadian gas companies for over 20 years.

You can't sell gas that leaks out before it reaches the meter.

Write for details about gas conserved by companies using the HEATH SURVEY method.

HEATH
Survey Consultants, Inc.
573 WASHINGTON STREET, WELLESLEY 81, MASS.



Daniel Knapp, in the cast of PG&E's road show, counts on his fingers in an attempt to outdo the electronic brain at left. The brain is predicting conditions in 1965 that will affect the utility business, PG&E's share of that business, especially.

which will include a special movie, showing of anamorphic "wide-screen" slides, and a "live" stage show.

According to O. R. Doerr, vice president in charge of sales, the first showing was in Stockton on Jan. 23. Other cities on the schedule are Sacramento, Santa Rosa, Oakland, San Francisco, San Jose, Salinas, San Luis Obispo, Bakersfield, Fresno, Auburn, Marysville, Chico, Redding, and Eureka. It is expected that a large percentage of the company's 17,583 employees will be able to see the presentation at one of these engagements.

Mr. Doerr said the purpose of the show is to acquaint all employees with the company's activities and to outline company objectives for the near future. The first act will be a sound movie of PG&E's officers in the general office building in San Francisco discussing the past year's activities and aims for 1956. The act includes a slide presentation by a company officer describing company services. Terms like "12,587,000 tons of dishes washed by families in our territory each year; 5,800,000 tons of laundry handled each year—2½ times the weight of the San Fran-

JORDAN-ROGERS

answers service line replacement problems . . .

SHORT LENGTHS FOR EASY USE

INSIDE COUPLINGS • HIGH FLOW RATE

Now save on both time and material on gas service line replacement installations with Jordan PVC — made especially for the job! Easy-to-handle 20-foot lengths slip thru old lines in a jiffy . . . prevent binding . . . solve storage, trucking and installation problems! Jordan INSIDE COUPLINGS complete this money-saving package developed especially for the Gas industry!

Jordan PVC is made of high impact Goodrich Geon* polyvinyl materials — created to withstand rough handling. Jordan PVC won't corrode, has better chemical resistance, provides a higher flow rate and costs less than many other pipe materials.

**Geon is a trade mark of the Goodrich Chemical Company.*

Write today for full information on the new Jordan 20-foot length Gas Line Replacement PVC — or complete Jordan Catalog.

PLASTIC PRODUCTS

JORDAN ROGERS COMPANY ORANGE, CALIFORNIA

From the Largest Plastic Extrusion Plant in the West

cisco-Oakland Bay Bridge," are used to dramatize the importance of gas and electric service to customers of the company.

The second act, in addition to an anamorphic slide presentation of features of the company, will include four live skits by PG&E members dramatizing events of the past year. The third act will open with Chairman of the Board James B. Black's message to employees. Following this, skits will depict life 10 years hence when wonders of the not-too-distant future are realities in the utility world.

Cascade completes first stages of financing

The first phase of Cascade Natural Gas Corp's financing, which will total more than $20 million in the next several years, was completed recently when a check for $3.5 million was delivered to President Stewart Matthews and C. Spencer Clark, chairman of the board, by the underwriting firm of White, Weld & Co.

H. L. Remmel (right), of White, Weld & Co., hands over $3.5 million check to Stewart Matthews of Cascade Natural while C. Spencer Clark, also of Cascade, looks on. This transaction completed the first phase of the company's $20 million financing program.

Initial financing was accomplished by the public sale of securities consisting of units of one share of common stock and one 5½ five-year interim note, the units having a subscription price of $54.50.

Later in the year Cascade will complete its second phase of financing totaling $9.1 million through the private placement of 20-year, 4⅜% mortgage bonds. This money will be drawn as needed during 1956 and the early part of 1957.

Selas Corp. moves to Philadelphia suburbs

Selas Corp. of America has moved from its Philadelphia site to a new million-dollar plant in the suburbs just north of the city which has been developed to provide fully coordinated fa-

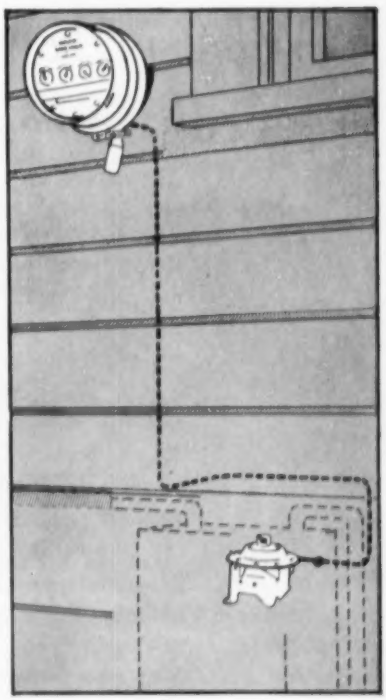
There's nothing like a tender, toothsome meterman to keep an alligator on his toes.

Gives him that body tone . . . puts more whip in his tail. In fact, independent surveys show that four out of every five domestically-housed alligators prefer meter readers over any other kind of snack including wild duck, stewed prunes and small children under five years old.

If your meter readers still have to go down into dark, unfamiliar cellars where there are always lots of surprises, you might pass the word along. Especially since, oddly, most health and accident policies don't cover this kind of a demise.

Of course, what you could do is arrange to have your meter readers get the reading outdoors. And you can do this by installing Sangamo Gas Telemeters on your present tin meters . . . brings the reading right outside the house. Be a lot of disappointed alligators—but then you can't please everybody nowadays.

We wrote everything down we thought you'd like to know about Telemeters and had it published under the title, "Outdoor meter reading is here . . ." or Bulletin 802. We've reserved a copy for you, so write for it today.



it's easier to get the reading ON THE OUTSIDE!

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

GT56-2

cilities for all of the company's activities. The plant is located on an 11-acre site, 14 miles north of downtown Philadelphia in Dresher, Pa.

All research and development is now concentrated in one centrally located building specifically designed for intensive study of heat and fluid processing. The only exception is the ceramics laboratory, which adjoins the ceramics production area in the manufacturing building, for convenience to the necessary kilns.

William S. Sims, supervisor of sales engineering, suburban division, Philadelphia Electric Co., opens the valve supplying the new Selas plant with up to 60,000 cfh of 801-Btu mixed gas. George M. Ager, Selas maintenance superintendent, looks on. In addition to space and water heating, gas will be for firing ceramics and brazing, and for combustion and heat processing research, pilot operation of newly developed processes, and full-scale testing of manufactured equipment.

The manufacturing building, containing all production equipment as well as parts and raw-material storage, adjoins the laboratory. Curtain-type interior wall construction and special mounts for production machinery provide the flexibility to adapt this area to any future pattern of production requirements. A third building houses engineering and administrative offices and such service facilities as archives, library, and cafeteria.

Lone Star buys first Cobaire air conditioners

Lone Star Gas Co., Dallas, bought the first air conditioners off the production line at Cobell Industries and will distribute the Cobaire gas-fueled condensing units through some 425 retail outlets.

Initial production for Lone Star will be primarily 3- and 5-ton units. Somewhat smaller than an average office desk, the units require no special equipment rooms and they may be installed remote from the cooling coil. Utilization of existing duct work in homes equipped for central heating is one of the selling features of the Cobaire.

Spokane Gas contracts with Kaiser for fuel delivery

Spokane (Wash.) Gas & Fuel Co. and Kaiser Aluminum & Chemical Corp. have signed one of the largest fuel contracts ever awarded in the Northwest. The $20 million 20-year contract calls for delivery of 8.2 MMcf

Question to management...

What is the real worth of Cathodic Protection?

The real worth of cathodic protection depends primarily upon its effectiveness after it is installed. Inadequately designed or improperly installed systems will not do the job. Savings on your corrosion control costs can best be obtained with experienced E. R. P. corrosion engineers working with your staff.

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ATLANTA CHICAGO DALLAS MONROVIA SEATTLE

E-31

of gas/day to the Mead and Trentwood plants.

Nathan H. Gellert Jr., Spokane president, said Kaiser would be the largest natural gas consumer in the Spokane area, where the anticipated load will be 30 MMcf daily in the next five years.

Norman L. Krey, Northwest operations manager for Kaiser Aluminum, said his company will have a number of industrial applications for the fuel, largest of which will be to fire remelt furnaces at the Trentwood rolling mill. Other uses will include boiler houses for heating and process steam, carbon baking furnaces, and heat treating. In most cases, gas will replace oil.

Trentwood will receive service from a 20-in. supply main, which will also serve other industries and homes in the Spokane valley. Officials of Spokane Gas estimate that the cost of facilities to serve Kaiser will be $250,000. Fuel requirements of Kaiser were estimated to be 3 billion cu ft of gas a year.

American Controls has new engineering department

In order to insure high quality of its products and to develop new production techniques, American Controls division of Robertshaw-Fulton Controls Co. has established a unified engineering department at its St. Louis plant which brings under single direction all testing and quality control functions at the division.

A key function of the new engineering department is the operation of control devices and their components under stress conditions often more severe than they would undergo in ordinary use. The department will also develop its own engineering data, which was formerly provided by other company divisions.

Gas transport by water tested in Louisiana

Last month Continental Oil Co. began preliminary testing of a two-barge assembly for liquefication of natural gas and the movement of the liquefied natural gas by water. Test site was Bayou Long in Louisiana.

One completed barge is a floating liquefication plant. The other barge, designed to carry five insulated cylindrical vessels of about 110,000-gal. capacity each, has two such containers in place for testing.

If the testing is satisfactory, and the U. S. Coast Guard approves, actual liquefied gas movement between Louisiana and Florida is contemplated. If such barge movement works out, an ocean-going tanker is said to be in mind.

SNUG TO THE WALL of a railroad underpass is the trench being dug by this compact Cleveland "Baby Digger." Its ability to put the edge of a trench within less than two feet of a parallel wall is but one of this Cleveland's many practical operating advantages.

DIGGING CLEAN AND FAST the same Cleveland "Baby Digger" turned out high daily production on this job. With more than 30 usable digging speeds at the operator's command, the Cleveland cut cleanly through pavement and heavy root growth for trench 22 inches wide by 41 inches deep. Performance like this has made Clevelands *first choice* in the gas industry for over 30 years.

Talk it over with your Cleveland distributor

THE CLEVELAND TRENCHER COMPANY • 20100 St. Clair Ave., Cleveland 17, Ohio

CLEVELAND

Rockwell buys new plant in Statesboro, Ga.

Rockwell Manufacturing Co. has purchased a new plant at Statesboro, Ga., from General Instrument Corp. which will be used to manufacture a variety of Rockwell meter, valve and other products.

The plant, located on a 33-acre plot, is about 50 miles northwest of Savannah. It includes 80,000 sq ft of manufacturing space and 26,000 sq ft of office and service areas.

GAS news notes

New York State Electric & Gas Corp. has applied to the New York PSC for authority to provide natural gas service to approximately 7300 customers in Lockport and surrounding areas of Niagara and Orleans counties.

White-Rodgers Electric Co., St. Louis, recently celebrated completion of its 7 millionth Hydraulic-Action control. The "milestone" control was 24-karat goldplated in honor of the occasion.

A 200-acre site in the Tri-Cities area of southeastern Washington has been purchased by Phillips Pacific Chemical Co. for construction of an ammonia plant which will use natural gas as a raw material. Phillips Petroleum Co. and Pacific Northwest Pipeline Corp., which will supply the gas, are joint owners of Phillips Pacific. The plant is scheduled for completion late in 1956. It will have a daily production capacity of 200 tons of anhydrous ammonia.

Columbia-Geneva Steel division of United States Steel will market a new polyvinyl-chloride plastic pipe product in the seven western states. Two types will be distributed—normal impact and high impact—in sizes ranging from ½-in. through 4-in. Sizes up to 6-in. will be extruded to order. U. S. Steel's National Tube division is manufacturing the plastic pipe.

Southern Counties Gas Co. passed a major milestone in its 45-year history last year—connection of more than 500,000 active meters—when it gained 50,639 new customers. At year-end, the Los Angeles utility was serving 548,422 customers, a gain of 10% over 1954. Number of meters gained in 1955 set a new yearly record, topping the previous high of 39,097 meters in 1954.

Kentucky's house of representatives has passed and sent to the senate a bill that would require natural gas service to be furnished any person living within half a mile of a gas well or a gas pipeline, providing the applicant pays cost of installation.

A-P Control Corp., Milwaukee, and Soreng Products Corp., Schiller Park, Ill., have been merged, according to Roy W. Johnson, A-P president, and Louis Putze, president of Soreng. The new corporation will be known as Controls Corp. of America and will be headed by Mr. Johnson as chairman of the board and Mr. Putze as president.

Equitable Gas Co.'s 195 compression station department employees in Pennsylvania and West Virginia were honored recently by the company when they set a safety record of 1 million manhours without a disabling injury. The perfect accident prevention record spanned a 2½-yr period starting in 1953.

Two sales representatives in the Northwest area have been appointed by Eclipse Fuel Engineering Co., Rockford, Ill. Brown Engineering Co. will represent Eclipse in Seattle while Kleenaire Products Corp. will represent the company in Portland.

LOCATES VALVES QUICKLY

even under heavy snow, ice, black top

the NEW

AQUA VALVE BOX LOCATOR

The miraculous new Aqua locator takes you directly to the valve box . . . *even when the ground is covered with snow, ice or black top.* Saves hours of back-breaking digging in hard, frozen ground.

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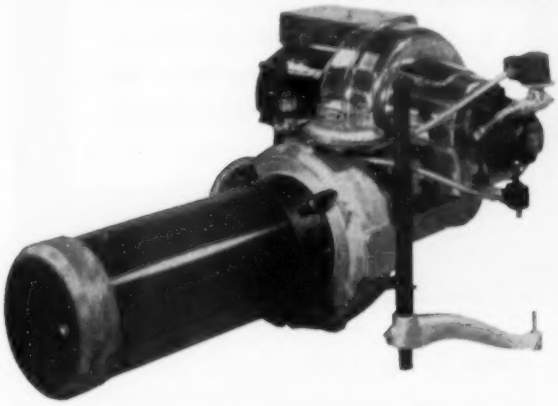
Webster's New



CYCLONETIC*

DUAL FUEL BURNER

The Webster Cyclonetic* represents another step in the continuous effort of the Webster Engineering Company to provide the industry with carefully designed and tested combustion equipment, capable of satisfying the requirements of those who demand the ultimate in quality and service.

The development of the Cyclonetic* introduces a unique method of accomplishing flame retention and stability of a gas flame in a gun-type burner with no sacrifice of efficiency or safety when firing either gas or oil.

•

The Webster Cyclonetic* Dual Fuel Burner is designed to operate on either gas or light oil with only the flick of a switch necessary to change from one fuel to another. Employing 100% forced draft, the Cyclonetic* provides fully automatic operation on both fuels, with complete programming and safety built in.

Quiet — Dependable — Fully Equipped

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TULSA, OKLAHOMA
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Gas Digest

A digest of what's new in products and trade literature compiled by the editors of GAS as a reader service.

New Products and Trade Literature

For more data on any of these items use the Readers' Service Cards on pages 115, 116

1. Plastic vent cap

This low-priced plastic vent cap is designed to prevent plugging of vent ports by insects or corrosion products and to stop rain water from entering the regulator.

It has long, narrow venting slots which allow ample venting capacity but are too narrow to be plugged by insects and are so positioned that the entrance of rain water is prevented.

The plastic material is Cycolac, which has exceptional impact strength, toughness, and good resistance to outside weathering. To reduce regulator pulsation, the vent cap can be supplied with a stainless steel disc in the cap which acts as a check valve.

Modern Utility Supply Co.

■

2. Self-propelled crane

Schield Bantam's new self-propelled crane and excavator offers one-man operation, two-speed independent drive, a no-shift forward-reverse travel design, and 19½-ft outside turning radius.

Interchangeable parts of the new Model CR-35 include crane, clamshell, dragline, magnet crane, pile driver, grapple, back hoe, shovel, and backfiller.

Schield-Bantam Co.

■

3. Excavator

Production of a new version of its Model 205 excavator has been announced by the Koehring Co. The Cruiser Crane, one-man operated, has a 15-ton lifting capacity, ½-cu yd dipper capacity, and a top travel speed of 21 mph for fast shuttle operation. Gradability tests show that the machine can negotiate 25% grades in low gear.

The Cruiser Crane is best suited for odd-job service and in installations where handling equipment must be shifted quickly from one job location to the next.

One engine supplies all power and a 4-wheel drive arrangement provides extra tractive power. Other features include power steering, air-hydraulic brakes, and a standard torque converter.

Koehring Co.

■

4. Glass-lined water heaters

Ruud Manufacturing Co.'s new Pacemaker series of automatic storage gas water heaters (glass-lined) consists of two units.

Model EP 30-25 has a storage rating of 30 gal., a recovery rating of 25 gal./hr, and a 1-hr performance rating of 55 gal. The larger automatic gas water heater, Model EP 40-30, has a storage rating of 40 gal., a recovery rating of 30 gal./hr, and a 1-hr performance rating of 70 gal.

Ruud Manufacturing Co.

■

5. Valve power unit

A valve power unit for controlling gas pressure build-up in supply lines has been developed by Eclipse Fuel Engineering Co. According to the manufacturer, the Series R reverse-acting power unit, combined with an Eclipse Lock-Tite safety shutoff valve, will positively shut off gas supply to the burner in case incoming pressure builds up beyond a safe point.

Developed specifically for applica-

For additional information use Readers' Service Cards on pages 115, 116

tions where over-pressure protection is essential, these power units may be applied to all Eclipse Lock-Tite valves. It is also possible to combine reverse-acting power units with standard LT power units to provide protection for pressure failure as well as excessive pressure build-up. These units are available in four standard tripping pressures ranging up to 10 psi.

Eclipse Fuel Engineering Co.

■

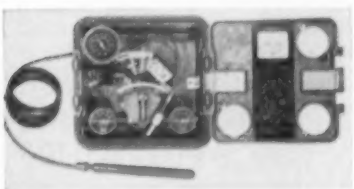
6. Pocket-size amplifier

A new pocket size, transistorized audio-amplifier from Fisher Research makes possible detection and amplification of a wide variety of industrial sounds—sounds produced by termites, fluid leaks in radiant heating systems and buried pipelines, and by defective bearings or other moving mechanical parts.

Amplification to 85 lb gain is provided by three miniature, hermetically sealed, low noise transistors. Power is supplied by a single, small dry cell battery good for approximately 100 hr of normal use.

Fisher Research Laboratory Inc.

■



7. Temperature controller

Positive fluid flow control through diaphragm- operated valves, based on temperature variations, is the job of Black, Sivalls & Bryson's new 1460 temperature controller.

Equipped with an external vapor-tension thermal system to actuate the power unit in the pilot, the 1460 offers a choice of temperature ranges. By simple adjustment, it permits either 100% throttling action or "on-off" snap action within a wide limiting range. Two pressure gauges and a temperature indicator are compactly built into the pilot case.

Black, Sivalls & Bryson Inc.

■

8. Air compressor

Jaeger's new Roto Air Plus air compressor is useful for gunite work and heavy duty sand blasting, or for operating a heavy duty wagon drill and hand-held rock drill simultaneously, because of its larger capacity. Delivering 365 cfm of air, this new compressor has an unusually low operation speed of 1700 rpm.

Instant-acting controls, with continuous, stepless regulation of engine speed to air demands, maintain 100 psi minimum air pressure under all normal working conditions. Two-stage compression and tube finned multipass oil cooler result in air temperatures at the manifold 100° cooler, it is claimed.

Jaeger Machine Co.

■

9. Low frequency radio

Motorola's new Handie-Talkie low frequency radio paging system makes possible private, individual paging of institutional personnel and key administrators. The new system individually alerts and informs the paged staff member anywhere within a restricted plant or building area.

The system consists of a selector console with individual buttons for key personnel, an FM transmitter that radiates alerting tones and voice messages within a confined induction loop area, and the individual all-transistorized Handie-Talkie radio receivers.

A receptionist or telephone operator merely presses the proper selector button to activate a particular pagee's receiver-alerting mechanism, then speaks the message into a desk microphone. No other receiver in the system hears either the alerting tone or the voice message.

Motorola Communications & Electronics

■

10. Built-in units

Geo. D. Roper Corp.'s "arRANGEable" built-in gas cooking units are now available with Tem-Trol controlled-heat top burners.

In addition, the built-in units feature Insta-Matic oven guardian for fully automatic oven cooking, Super Alltrol center-simmer top burners, Bake-Master oven, and Silent-Roll smokeless broiler.

Geo. D. Roper Corp.

■

11. Plastic fittings

A new solvent cement for joining PVC (polyvinyl chloride) pipe fittings and flanges makes possible a joint as strong as the pipe itself, according to Tube Turns Plastics Inc., and will bridge a greater diametral gap.

An ordinary paint brush will usually serve as the applicator for the solvent cement. A cemented joint can be handled in 1 hr and reaches working strength in 48 hr. It permits the solvent of any SPI-approved piping of PVC. The solvent is available in pints, quarts, or gallons.

Tube Turns Plastics Inc.

■

For additional information use Readers' Service Cards on pages 115, 116

12. Winter air conditioners

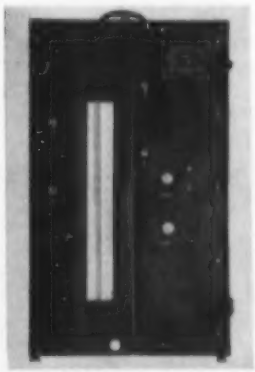
Three new Gordonair hiboy and loboy winter air conditioners—with 80,000, 100,000, and 125,000 Btu inputs—are in production at Roberts-Gordon Appliance Corp.

Suitable for basement, utility room, or closet installation, the line is designed for the addition of summer cooling units at any time.

Features include the Gordon single-port spreader-flame burner, heavy gauge steel die-formed heat exchanger, and rubber-mounted double-inlet, centrifugal-type blower.

Roberts-Gordon Appliance Corp.

■



13. Gas flow calibrator

National Instrument Laboratories new Model 40 gas flow calibrator is a dual-range instrument provided with two high precision, all-metal, Vol-O-Flo meter elements which may be individually connected to a single manometer. Flow measurements up to 30% of full scale are made with the low flow element, the high flow element being used for the rest of the range.

Laminar flow characteristic of the Vol-O-Flo and the low Reynolds number for which it is designed make it inherently reproducible and ideal for use as a flow standard. High full scale accuracy permits measurements of flow over a 13/1 range of better than 1% of indicated flow and over a 33/1 range to better than 2½% of indicated flow.

National Instrument Laboratories.

■

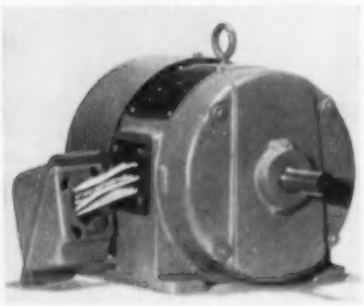
14. Timer valves

With new timer valves available from the Automatic Controls Corp., flow of liquids, gas, or air can be controlled automatically. The units, which consist of a solenoid valve and a timer control sealed in a water-tight case, turn the flow on or off at desired time intervals. They fit all standard pipes, ⅜-in. and larger, and operate on 110- or 220-volt, 60-cycle current.

The timers can be used to turn a flow either on or off, or both on and then off, at any desired time. They can perform this function each day with repeat-cycle operation. The timers can also be used to obtain continuously intermittent operation: they can be set to open and close a valve a certain number of times per minute, hour, or day.

Automatic Controls Corp.

■



15. "AC" motors

Replacing a single line of 1-5 hp motors, General Electric has two new "AC" lines of enclosed, non-ventilated, fan-cooled motors designated as Standard Enclosed and Severe Duty Enclosed.

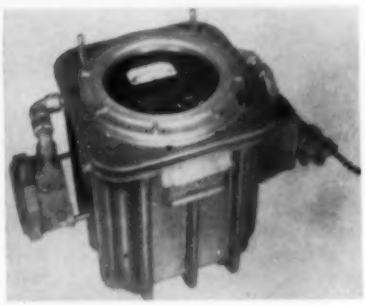
Both new lines feature longer permanumbered leads for use with time-saving wire nuts. Every enclosed, foot-mounted motor is equipped with a lifting eye.

The Standard Enclosed motor features a steel conduit box and fan cover. The conduit box has "keyhole" mounting for quick and easy installation.

The Severe Duty line is basically the same as the standard, except for certain features that make this line suitable for use in corrosive or excessively moist atmospheres.

General Electric Co.

■



16. Gas alarm system

Development recently by Davis Instruments is a completely self-contained portable analyzer and alarm system for combustible gases.

The continuous sampling system, which is operated by a motor-driven pump mounted inside the unit, features visual and audible high-gas signals; large, readily visible meter calibrated to 0 to lower explosive limit, showing gas or vapor concentration at all times; built-in trouble-indicating circuit with indicating light and audible signal.

Davis Instruments

■

TRADE LITERATURE

17. Brazing, soldering data

"Production Brazing and Soldering" is the title of a new bulletin from Selas which describes a fast, economical method of high-strength assembly utilizing Selas gas-fired automatic heat processing machines.

Selas Corp. of America

■

18. Prefabricated house report

Sturdybilt prefabricated houses — for home, field office, warehouse, or complete field camp—are described in

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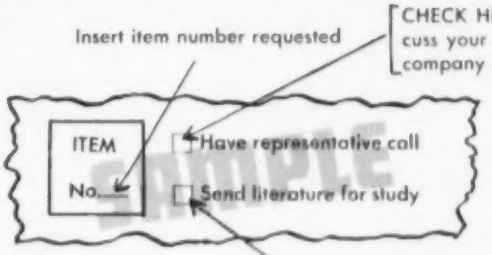
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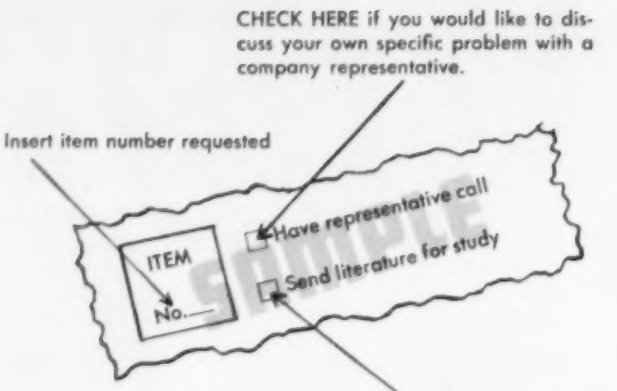
CHECK HERE if you would like to discuss your own specific problem with a company representative.
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ITEM No.
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COMPANY _____

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Note how these Reader Service Cards are *Specialized* so that you may . . .

☑ Request a company representative to call to discuss your own specific problem, or . . .

☑ Request data only, to study the application of the product or service to your own specific needs before talking with a company representative.

a 20-page catalog from Southern Mill & Manufacturing Co. Top quality in architectural design and materials, economy and precision of factory prefabrication, and demountability (high material salvage for relocation) are claimed for these prefabricated, sectional homes. Both economy and executive homes are available, and the catalog is devoted to descriptive and illustrative material covering them.
Southern Mill & Manufacturing Co.

■

19. Gas scrubber bulletin

Bulletin 457 from the Moorlane Co. describes that company's gas scrubbers in detail. In addition to specifications on the scrubbers, the bulletin presents principles of operation, discusses the various types of differential gauges available, and presents operating and maintenance instructions on the scrubbers, which are designed to trap foreign matter in gas streams.
Moorlane Co.

■

20. Burner brochure

The Mettler Fan-Air gas burner for forced, induced, or natural draft operation in power plants is described in a new bulletin (G-200-B). Illustrations, descriptive information, and specifications are presented on the burners, which are available as completely packaged, fully automatic heating systems in capacities ranging from 400,000 to 25 million Btu input.
Mettler Co. Inc.

■

21. Scale indicator data

Honeywell's Tel-O-Set vertical scale indicator, used to measure and control process variables such as temperature, pressure, flow, and liquid level, is described in Bulletin 7202. Up-to-date information on the Tel-O-Set recorders and controllers is also included.
Minneapolis-Honeywell Regulator Co.

■

22. Compressor catalog

A new and interesting booklet on Clark Turbo-Supercharged compressors has recently been released by the company. The booklet points out that this line of compressors uses 40% less water for cooling than ordinary compressors. Also, because of the turbo-charger, the compressors are reported to operate on 10% to 12% less fuel than conventionally scavenged compressors.
Clark Bros. Co.

■

23. River weight charts

Six worth-while charts for determining the size and number of river weights for any particular crossing are contained in a new booklet on pipeline accessories by Allan Edwards Inc. Also included in the booklet are illustrations and specifications on a range of welding sleeves and half soles. Illustrations on the use of Sillers Flex Ring closures for pipeline scraper traps, blowdown service and other applications are also included.
Allan Edwards Inc.

■

24. Indicator booklet

A magnetic-amplifier-type deflection indicator, applicable to any equipment in which early detection of relative movement is desirable, is described in a new eight-page bulletin (05B8385) released by Allis-Chalmers. The indicator is designed to safeguard hydrostations, compressor and pumping stations, drive shafts and other applications.
Allis-Chalmers Manufacturing Co.

■

25. Fire protection manual

The various generally accepted methods of fire detection, fire prevention, fire control, and fire extinguishment associated with the field of special hazard fire protection have been covered in a new publication from Automatic Sprinkler Corp. A fire control and extinguishment chart covering fire hazards involving flammable liquids, fast-burning or explosive solids, and the major applications of fire control medium is presented.
Automatic Sprinkler Corp.

■

26. Fittings publication

A new booklet has been released on the line of Telsco malleable iron threadless fittings for joining iether steel or plastic pipe. The bulletin includes complete information on the company's couplings, adapters, elbows and tees in sizes from ½ to 2 in. The metal stiffeners recommended when the fittings are used with plastic pipe are also described.
Telsco Fittings Division

27. Pipe accessory tools booklet

A new line of pipe-driving accessory tools adaptable for driving pipe up to 2 in. or for replacing old pipe with new is described in a new brochure from Delaware Tool Steel Corp. Pipe-DrivR accessory tools are for use with standard pneumatic paving breaker hammers. It is claimed that the new design protects mill wrap against stripping in the driving operation.
Delaware Tool Steel Corp.

■

28. Direct-current motors data

General Electric's new fractional horsepower direct-current motors and equipment are featured in a 12-page bulletin. Designated GEA-6068, the illustrated bulletin covers the complete line for direct application and built-in use. Typical applications, product features, ratings, and specifications for standard models are included.
General Electric Co.

■

29. Excavator crane manual

Complete specifications and working ranges on the Bucyrus-Erie 15-B excavator-crane are contained in a new bulletin (15-B-4). The 40-page bulletin is generously illustrated with on-the-job photographs and close-ups of mechanical features of the new ½-yd shovel, which is readily convertible to dragline, clamshell, dragshovel,or lifting crane.
Bucyrus-Erie Co.

■

30. Activated carbon brochure

A new booklet on the uses of activated carbon has been released by the Girdler Co., catalyst department. The booklet describes the use of the material for air and gas purification, adsorption and other purposes. It contains a partial list of the products and processes using activated carbon.
Girdler Corp.

■

31. Air conditioning report

Mueller Climatrol's new all-purpose booklet, "Making the Weather Behave," is available in two forms. One has a 16-page insert containing specifications and dimensions on every size and type of unit in the Mueller Climatrol heating and air conditioning line, while the other is available for consumer use—without the insert.
Mueller Climatrol

Pipe that won't corrode ever!

BUSADA Pipe is accepted by gas companies because of its low installation costs and consistently high quality. BUSADA Butyrate Pipe won't corrode because it can't corrode!

You're reading this issue — so corrosion must be a problem to you. But now you can forget it, at least so far as piping is concerned. For BUSADA Transparent Pipe completely eliminates corrosion as a piping problem. Be sure to specify BUSADA Pipe for IPS-OD*, transparency and a complete line of fittings.

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FULL AND HALF CABS

Full Cab and Model 1511 King Winch Illustrated

- Protection
- Comfort
- Safety
- Convenience

Roll-down windows, full opening . . . full panel-board head lining and masonite door lining . . . safety glass throughout . . . all-steel welded construction . . . door locks.

KING WINCHES

King Winch on R-140 and R-160 International

There's a front-mount King Winch designed to fit your specific needs . . . for ½-ton through 2½-ton trucks . . . pulling capacities of 8,000 to 19,000 lbs.

P.T.O.-driven King Winch on Willys Jeep FOR ALL WILLYS JEEPS, 4 WD TRUCKS AND 4 WD STATION WAGONS.
Power-take-off-driven King Winch models 1301 and 1311 for CJ-3B and older-model Jeeps, can be transferred to CJ-5 and CJ-6 Jeeps . . . nothing extra needed.

Koenig cabs and King Winches for Willys vehicles available through all Willys Motors, Inc., dealers and distributors in U.S.A. . . . and Willys-Overland Export Corp. distributors in other countries.

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A LIQUEFIED PETROLEUM GAS OF HIGHEST QUALITY

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NEW YORK, NEW YORK
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COLUMBIA, SOUTH CAROLINA
TAMPA, FLORIDA

GAS associations

Panels and gas panorama to highlight NEGA meet

March 22-23 are the dates for the 30th annual meeting of the New England Gas Association. Meeting place is the Hotel Statler in Boston.

In addition to the usual business affairs of an annual meeting, the convention will feature two panels and a "national gas industry panorama."

The first panel, on Thursday afternoon, March 22, will center around "Building Desirable Group Relations," and cover employees, customers, communities, stockholders, publications, bankers, dealers, government, suppliers, and competitors. Paul V. Hayden, vice president of the Connecticut Light & Power Co., will be moderator, while Horton L. Chandler, NEGEA Service Corp., and Charles E. Downing, Eastern Gas & Fuel Associates, will represent the gas industry. From the public relations field will be Richard P. Axten, Raytheon Manufacturing Co., and Frederick Bowes Jr., Pitney-Bowes Inc.

Friday morning's session will be the panorama, with William B. Hewson, Brooklyn Union Gas Co., acting as master of ceremonies. Discussions and speakers are Harold Massey, GAMA, 1956 appliance improvements; Thomas Lee Robey, AGA, air conditioning research; Christy Payne Jr., Peoples Natural Gas Co. and chairman of the AGA general promotional planning committee, AGA and GAMA promotion and advertising; Frank H. Trembly, Philadelphia Gas Works and chairman of the AGA TV committee, "A National TV Program for the Gas Industry"; Remick McDowell, Peoples Gas Light & Coke Co. and chairman of the AGA public information committee, AGA public information program.

Other participants are W. F. Rockwell Jr., Rockwell Manufacturing Co., who will deliver his GAMA president's presentation, and AGA President Dean H. Mitchell, Northern Indiana Public Service Co.

On Friday afternoon "cooperating with our industry allies" is the topic for discussion. Cooperative means to

be touched on include general cooperative policies, gas utility contact personnel, kinds and costs of advertising, combining sales and servicing by dealers, sales and service training for dealers, and load-building activities.

Henry A. Kievenaar, Boston Gas Co., will chairman the panel, which is composed of Robin A. Bell, Surface Combustion Corp.; Charles A. Byron, Connecticut Light & Power; Julius Klein, Caloric Appliance Corp.; R. Louis Towne, executive director of Plumbing & Heating Wholesalers of New England Inc., and representatives of architects, builders, and realtors.

Pipe Line Contractors elect Bledsoe president

C. C. Bledsoe, vice president and treasurer of Midwestern Constructors Inc., Tulsa, was elected president of the Pipe Line Contractors Association at the group's annual meeting in Boca Raton, Fla. He succeeds H. C. Price, of H. C. Price Co., Bartlesville.

Other officers are Earl Allen, Associated Pipe Line Contractors Inc., Houston, first vice president; John H. Williams, Williams Bros. Co., Tulsa, second vice president; and Kenneth A. Owen, Parkhill Truck Co., Tulsa, treasurer.

Directors: Jack S. Gray, Grayco Construction Inc.; R. P. Gregory, Houston Contracting Co.; James P. Neill, Western Constructors; M. S. Williams, Panama Williams Corp.; G. A. Manuel, Williams Austin Co.; Robert D. Sheehan, Sheehan Pipeline Construction Co.; and R .A. Conyes, Conyes Construction Corp. Richard A. Gump, Dallas, is executive secretary of the pipeliners.

Midwesterners planning 51st annual convention

The 51st annual meeting and convention of the Mid-West Gas Association will convene at the Hotel Fontenelle in Omaha, Neb., on March 19.

One of the highlights of the three-day meeting will be a panel discussion on "How to retain full gas load in face of today's competition," presided over by A. M. Schultz, assistant sales manager of Minneapolis Gas Co.

Participants will include W. V. Bell, Metropolitan Utilities District, Omaha, discussing contractors' and builders' program; S. M. Johnson, Minnesota Valley Natural Gas Co., St. Peter, Minn., whose subject is gas dryer promotion; Carl J. Olson, Central Electric & Gas Co., Lincoln, Neb., discussing dealer program; and J. Roscoe Furber, Northern States Power Co., on annual gas appliance sales contest.

Home service activities will also receive special attention during the con-

"PANTHER" PLASTIC PIPE

. . ready to serve the pacific northwest with GAS service lines

ADVENT OF NATURAL GAS IN THE NORTHWEST, PUTS WESTERN PLASTICS CORPORATION IN AN EXCELLENT POSITION TO SERVE YOU!

Here is plastic pipe extruded to American Gas Association and the Society of Plastics Industry recommendations as to weight, dimensions and tolerances. There is no electrolysis with Panther Pipe and it is flexible, light weight, non-rusting and is a "natural" for gas service lines, either new installations or replacement of old lines. It can be joined to metal lines without expensive precautionary measures.

Enjoy the advantage of working closely with a local manufacturer who will meet all your requirements with this top quality plastic pipe. Write to us now for prices and more information.

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WESTERN PLASTICS CORPORATION

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PANTHER ®

"The Most Satisfactory Ditching Machine We've Ever Operated"

Say Jay Cundiff and Mac McVain

SOUTHWEST CONTRACTORS

BAINBRIDGE, GEORGIA

"We recently purchased our third Vermeer Model 4T Pow-R-Ditcher. This "Midget ditcher" is ideal for digging in those "tight spots." It is the most compact and satisfactory ditcher for gas service connections that we have found."

"Easy to transport," says Mac McVain.

VERMEER 4T POW-R-DITCHER DIGS FOR LESS BECAUSE IT COSTS SO MUCH LESS

The 4T Pow-R-Ditcher is only 44" wide and is easily transported in a pickup truck. Digs 6" to 14" wide and 4½' deep. Ideal for laying gas pipe, service lines and digging foundation footings. Only 6' high, 13' long, the 4T is self-propelled and one-man operated. Same size moving parts as larger models. Write for name of distributor and full information on the complete Pow-R-Ditcher line.

Some Excellent Sales Territory Available

VERMEER MFG. CO.

Pella, Iowa

"Well built machine and a fast digger," says Jay Cundiff.

Telsco. the tight-sealing
PRESSURE FITTING
that conducts electricity

Telsco Long and Short Couplings, Adapters, 90° Elbows, and Toes, ½ through 2 inches.

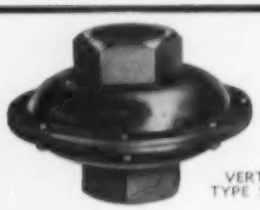
Use Telsco Fittings on Plastic Pipe, too—Metal Stiffeners for this application are available.

The unique sealing principle used in Telsco Threadless Fittings concentrates great pressure, under containment, on *all sides* of a *small* rubber gasket (See cross section). Under this tremendous pressure, confined in a small area, the gasket forms a tight seal against leaks.

At the factory every Telsco Fitting gets a 90-pound air pressure test, under water—assuring a sound casting every time.

Telsco Fittings do not insulate. Instead they conduct static electricity without the time, effort and cost of bonding every connection.

TELSCO FITTINGS DIVISION
5420 REDFIELD STREET DALLAS 19, TEXAS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Eliminate Air
In Gas Lines With
NORWALK
DIAPHRAGM TYPE
CHECK VALVE

Vertical Type in Sizes ⅜" thru 6"
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Norwalk Diaphragm Type Check Valves both Vertical and Horizontal, provide positive check against reverse flow of either gas or air. Rugged construction will stand back pressure to 50 lbs. Soft seat disc will seat freely when gas flows in desired direction or will seat tightly on equalized or back pressure. Valves for higher pressures supplied in special order.

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SAFETY
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Hundreds of gas distribution firms have materially improved their safety factor and substantially reduced "un-accounted for" by employing SOUTHERN CROSS FORESTERS to locate and repair their street leakage.

There is a plan to fit your system whether you maintain 5 or 5,000 miles of main.

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associations • *Continued*

vention. Myrna Johnston, director of foods and equipment department, *Better Homes & Gardens* magazine, has chosen "Look What's Going On in Kitchens" as her topic of discussion at home service luncheon, which will be presided over by Alice Keaton, home service director of Metropolitan Utilities.

Other speakers include: H. R. Slocum, president, Blue Flame Gas Association, "What Is the Blue Flame Gas Association?"; Sen. Roman B. Hruska, "Economic Outlook"; Harry Bowser, Servel Inc., "Little Things That Make the Sale"; John F. Merrian, president of INGAA and Northern Natural Gas Co.; Mrs. Amber C. Ludwig, equipment editor of *What's New in Home Economics*; Morris E. Jacobs, president of Bozell & Jacobs, "Public and Employee Relations"; R. L. Stephenson, Lone Star Gas Co., "Gas Industry Development Program—and You"; Howard White, Liquefied Petroleum Gas Association; Cliff Hall, Coleman Co., "Activities in the Field of Gas Air Conditioning" (a film).

Dean Mitchell and C. S. Stackpole, president and managing director of the AGA, will deliver a message from the national association at the opening meeting.

Legal symposium to cover gas legislation

The American Gas Association in cooperation with the Practising Law Institute will sponsor a second legal symposium covering natural gas legislation before Congress. The first such symposium was held two years ago in New York. The current symposium will be held at the Waldorf Astoria hotel, New York City, April 9-11.

Discussions will cover a broad outline of legislation before Congress. Viewpoints of producer, pipeline and distributing company on these subjects will be analyzed. Another topic will be the impact of proposed bills on contract prices.

One session of the symposium will be devoted to explanations and interpretations of recent judicial decisions on cases involving the Natural Gas Act. The discussion also will include other problems pertaining to distribution, underground storage and other operational topics.

Management conference offers challenging program

Timely and challenging programs have been worked out by the AGA purchasing and stores committee and the insurance-personnel committees of the

association as a part of the General Management conference, April 4-6, in Chicago at the Conrad Hilton hotel.

Chairman Fred W. Kraemer urges all personnel in the industry interested in purchasing and stores to attend. During two afternoon programs, formal papers will be presented on a number of important topics, including inventory yardsticks, warehouse design and material handling equipment, economics of the salvaging operation, and continuing or repeating requisition. An open discussion on purchasing and stores problems will be held at the second afternoon session. The third day's activity will be a field trip to visit facilities of the Pipeline Service Corp., Franklin Park, Ill.

E. S. Willis, consultant, employee benefits planning of the General Electric Co., will talk on the company's new comprehensive health insurance program for its employees at the joint meeting of the AGA insurance and personnel committees at the conference. General Electric has pioneered in the application of this type of insurance plan and the favorable vote of employees for the program is of great significance.

AGA committee heads announced by Mitchell

Dean H. Mitchell, AGA president, has announced the appointment of chairmen of various committees of the board of directors.

Among the new chairmen named for the 1956 association year are: R. A. Malony, Bridgeport (Conn.) Gas Co., chairman, general convention committee; R. R. Blackburn, Southern California Gas Co., Los Angeles, chairman, executive committee on excess liability insurance; Frank C. Smith, Houston (Texas) Natural Gas Corp., chairman, executive conference committee, with W. E. Mueller, Colorado Interstate Gas Co., Colorado Springs, vice chairman of that committee.

Mr. Mitchell will serve as chairman of the executive committee of the board. James F. Oates Jr., Peoples Gas Light & Coke Co., Chicago, will be chairman of the special committee of executives on public affairs, while Ernest R. Acker, Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y., will head the finance committee. G. H. Sandusky, Southern California Gas, is chairman of the committee on gas-appliances, and J. H. Dennis, Long Island Lighting Co., Mineola, N. Y., will be vice chairman of that committee.

Additional chairmen include N. B. Bertolette, Hartford (Conn.) Gas Co., laboratories committee, and William G. Rogers, East Ohio Gas Co., vice chair-

ARCCO
The World Over
—wherever there is gas
ARCCO-ANUBIS
'Dry-Air GAS
GRAVITOMETERS
This new Arcco-Anubis Dry Air Gas Gravitometer determines and records specific gravity of gases automatically corrected to the humidity content of the air. The difference in weight between a column of GAS and equal column of DRY AIR is measured. This ratio represents the true specific gravity of the sample.
One bell of the instrument is filled with gas which is being measured, and the other bell is filled with dry air. Otherwise, except for the new instrument having one column for gas and one column for dry air, the unit is identical in operation to the standard gas gravitometer. When calibrated and properly installed, these instruments require little attention other than to wind the clock, ink the pen, and change the chart. Send for bulletin No. 101.
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A Universal Tar Emulsion Breaker
Eliminate tar emulsion "headaches"
Produce dry tar efficiently
Save Money on Time, Steam Costs and Labor
Proved in use by over 100 Gas Companies
Write for information and sample
UNIVERSAL CHEMICALS CORPORATION
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man; N. C. McGowen, United Gas Corp., Shreveport, La., committee on natural gas reserves; W. L. Shomaker, Northern Natural Gas Co., Omaha, general nominating committee; H. R. Derrick, Alabama Gas Corp., Birmingham, PAR committee. Serving with him as vice chairmen will be John E. Heyke Jr., Brooklyn (N. Y.) Union Gas Co.; Henry A. Eddins, Oklahoma Natural Gas Co., Tulsa; and Edward G. Twohey, New England Electric System, Malden, Mass.

Other committee chairmen in 1956 will be: A. W. Conover, Equitable Gas Co., Pittsburgh, executive safety committee; Charles H. Mann, Columbia Gas System Service Corp., New York, committee of executives on taxation; F. D. Campbell, New England Gas & Electric Association, Cambridge, Mass., committee on atomic energy; Remick McDowell, Peoples Gas Light, general public information planning committee; James F. Purcell, Northern Indiana Public Service Co., Hammond, public information projects committee; Mildred R. Clark, Oklahoma Natural, New Freedom gas kitchen and laundry committee; R. M. Drevs, Peoples Gas Light, corporate secretaries committee; Robert T. Sprague, Cities Service Petroleum Inc., insurance committee; and F. W. Kraemer Jr., New Orleans Public Service Inc., purchasing and stores committee.

New officers of the Tulsa section of NACE were elected at a recent meeting. They are (from left): A. Walton, Royston Laboratories, treasurer; Dr. F. A. Prange, Phillips Petroleum, vice chairman; J. R. Cowles, Agra Instruments, chairman; and O. W. Everett, Oklahoma Natural, secretary. The group was addressed by Dr. W. F. Fair Jr., Koppers Co. Inc. and president-elect of the national association. He spoke on the use of coal tar coatings in structural and industrial applications.

Three groups sponsoring industrial sales confab

The 1956 sales conference on industrial and commercial gas will be the most comprehensive ever presented by the section, according to Chairman Lawrence E. Biemiller, who also announced that this year not only will the industrial and commercial gas section have a major part in the three-day meeting at the Hotel Roanoke, Roanoke, Va., April 17-19, but the Southeastern Gas Association and the Southern Gas Association will be co-sponsors.

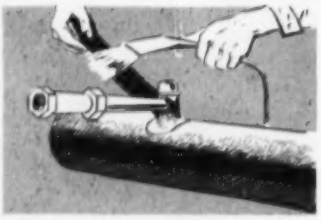
Following an established custom, the three-day conference will open with industrial gas day on Tuesday, a general session on Wednesday and on which day the formal luncheon and dinner

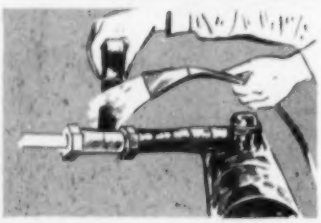
YOU CAN DEPEND ON PROTECTO WRAP FOR COATING GAS SERVICE FITTINGS

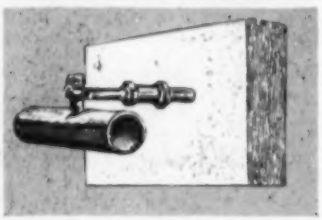
PROTECTO WRAP is well suited for wrapping gas service connections and other piping where fittings are used. It consists of a plasticized Coal Tar or Asphalt enamel, or microcrystalline wax, of the types used for pipeline coating, saturated into a glass fabric that acts as a carrier and reinforcement for the enamel.

The pliability of the bituminous material, when heated, enables it to be molded into conformation with the irregular surfaces. The strength of the glass fabric permits the application of the necessary tension.

A satisfactory technique for coating the various types of service connections used can be readily developed. The following sales representatives are available to demonstrate the material and method:







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PROTECTO WRAP COMPANY
2225 SOUTH DELAWARE STREET
DENVER, COLORADO

will be held, together with the friendship room reception. Commercial gas day on Thursday will conclude the conference. There will be specific topics presented for industrial gas men and reports of sales and campaign plans and case histories for commercial gas men.

This year's conference will have a well diversified selection of subjects. It will also cover sales, promotion and research activities of particular interest to department heads and management, and will provide an ideal opportunity of getting together on mutual problems, gathering information on new products and processes, and hearing inspirational talks.

Pennsylvania holds mid-year sales conference

A record attendance of nearly 400 representatives of utility companies, manufacturers, distributors and dealers were present at the mid-year sales conference of the Pennsylvania Gas Association held in Philadelphia. The theme of the conference, "Man Makes the Difference," referred specifically to the important part the salesman plays, not only in the advancement of the gas industry, but also the part the salesman has played in advancing business generally in this country. The meetings were under the direction of Medford Hazel, chairman of the sales promotion committee of the Pennsylvania association.

E. Carl Sorby, vice president, Geo. D. Roper Corp., opened the conference. He pointed out that the whole climate of selling has changed in recent years until today it is a profession of the highest order, and those who are in the sales profession have changed the old order to its status of a high profession because they have learned to service their customers and advise and counsel with them, so that the purchaser is obtaining the finest service from the fuel and the appliances sold to him.

C. S. Stackpole, AGA managing director, referred to the part that the manufacturers of appliances have played in advancing the interest of the gas industry. He reviewed, briefly, the new things that are being made available by these manufacturers and by the testing laboratories of the AGA. He also referred to the part the American Gas Association, through its promotional activities, has played in helping to develop a market for gas service to assist the salesman in his contacts with the American housewife. He closed his remarks by recounting some of his experiences in shopping department stores and dealers throughout the United States, in which he found that the average sales person made little attempt to sell the advantages of the mod-

IF YOU CUT LARGE DIAMETER PIPE...
YOU NEED THESE
New REED HINGED 4-WHEEL PIPE CUTTERS
Four sizes cover the range from 2½" to 12"

Users tell us these completely new cutters are so efficient they often "pay for themselves" through the savings in crew time on a half-dozen cuts. They are the first really practical tools for cutting off steel or cast iron pipe in sizes from 2½" to 12". You can, for example, cut 8" steel pipe completely off in less than five minutes.

Four wheel design requires minimum swing of handle—less digging in ditch work, easier "tight-corner" cuts.

Closed frame permits light weight with complete rigidity for better cutting.

4-point guide aligns the cutter on the pipe . . . assures perfect tracking and a right angle cut.

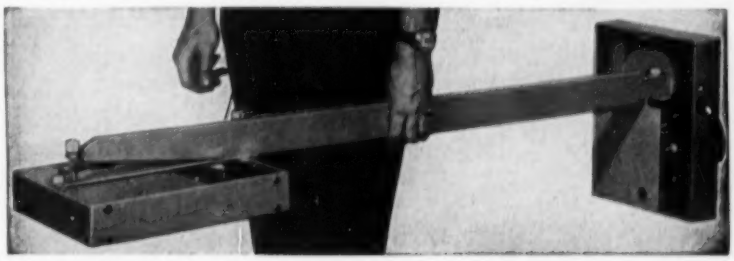
Reed Razor Blade wheels track perfectly, cut easily and roll down burr on steel pipe.

Unconditionally guaranteed to be the most efficient cutter you have ever used. Ask your jobber or write for literature.

REED MANUFACTURING COMPANY
ERIE, PENNSYLVANIA • U. S. A.

The WILKINSON LINE LOCATOR
SEES AND TELLS

It will instantly locate all subsurface pipes, cables and such, and determine their depth too. The etched circuitry, our latest innovation, assures better quality control and performance than the customary hand wiring method. You can avoid damaged structures and loss of time with the Wilkinson Line Locator.



The new loop antenna is designed for greater selectivity and the printed circuitry eliminates the usual variations. These improvements make this instrument outstanding.

Our instrument cases are now made with wear resisting phenolic material.

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The Gas Industry Professional Directory

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C. A. Johnson Bldg. Denver 2, Colorado ALpine 5-4581
1025 Vermont Ave. Washington 5, D. C. STerling 3-1929

Residential Heating and AIR CONDITIONING Appliance Design Engineers

•

Leading national FURNACE MANUFACTURER in SOUTHERN CALIFORNIA seeking design engineers to keep pace with growth. EXPERIENCE IN RESIDENTIAL HEATING EQUIPMENT ESSENTIAL. AIR CONDITIONING knowledge not essential, but REAL OPPORTUNITY for men with this experience. OPENINGS AT SEVERAL LEVELS. Excellent opportunity for men who can grow with job.

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198 S. Alvarado St., Los Angeles 57, Calif.

FOR SALE

Approx. 2700 feet of 16" O.D. Electric Weld Line Pipe, black, P.E., Bev. 30°, 52.36#, 5/16" wall in double random lengths, coated by Hill Hubbell, Specif. BMGA-2. This is new pipe, in stock, located in southeastern Massachusetts. Contact Fall River Gas Co., Fall River, Mass.

AIR CONDITIONING SALES ENGINEERS

•

OPPORTUNITY for Sales Engineer TO PLAN, DEVELOP, and ADMINISTER RESIDENTIAL AIR CONDITIONING SALES PROGRAM for a leading heating manufacturer in SOUTHERN CALIFORNIA. Ability to conduct and evaluate field studies, market research, and application surveys essential.

BOX 310 ,GAS
198 S. Alvarado St., Los Angeles 57, Calif.

ANCHOR'S BUTANE & PROPANE STAND-BY PLANT PACKAGE

ENGINEERING, INSTALLATION
Anchor's Engineering Dept. will design and supervise plant construction.

FINANCING
Anchor's experienced staff will assist with the financial details..

SUPPLIES
Huge tank car fleet, many plants and vast underground storage assure adequate supplies.

ANCHOR PETROLEUM COMPANY
TULSA — CHerry 2-7261

Be Completely Insured!
RELY ON
NEW ENGLAND FORESTRY SERVICE

the complete Gas Leak Location and Mitigation Survey Program

Vegetation Surveys*
Building Inspection Surveys
Commercial and Industrial Surveys

EDSON F. WHITE, *Operating Manager*

Special Representative
J. E. B. GIBBONS
44 ABBOTT ROAD, BRADFORD, PA.

Write, wire or phone COLLECT to
NEW ENGLAND FORESTRY SERVICE, INC.
281 MAIN STREET, READING, MASS.
Tel. REading 2-2525

*Originator of Vegetation Surveys for Gas Companies in 1934

ern gas range and its recent developments. He pointed out the necessity of educating Mrs. Homemaker to all the advantages of living the modern gas way, and stressing the fact that the women of America will have the final vote on whether we, as an industry, will remain in business.

John E. Heyke, president of the Brooklyn Union Gas Co., using the theme, "Man in Management," said "Management of the Brooklyn Union Gas Co., and I am sure of all gas companies, has recognized the importance of selling, particularly in today's market, and we are continually urging expanded sales programs." He stressed the fact that the industry had two roads it could take—it could sit idly by and cut expenses, content with holding its present load, or it could develop planned activities requiring greater expenditures and go out and sell. "I recognize," Mr. Heyke said, "that it is management's responsibility to provide the tools for you, as salesmen, if the industry is to continue its progress."

In the afternoon session, after the promotion uplift from the morning speakers, representatives of six manufacturers, in rapid fire style, reminded the salesmen present of the necessity to cover completely all the improvements of the appliances and the advancements made in the last few years. They quickly highlighted all of the modern techniques in the handling of a sale in today's market, relating their remarks specifically to the individual appliance they represented.

Program for NACE meeting in New York is completed

Complete arrangements for the technical program to be given during the 12th annual NACE conference and corrosion show at Hotel Statler, New York, have been announced. The March 12-16 meeting will have 14 symposia and numerous other events, which will include meetings of 62 technical committees.

The corrosion show, held concurrently with the conference, will display the products and services of 86 companies in 117 booths.

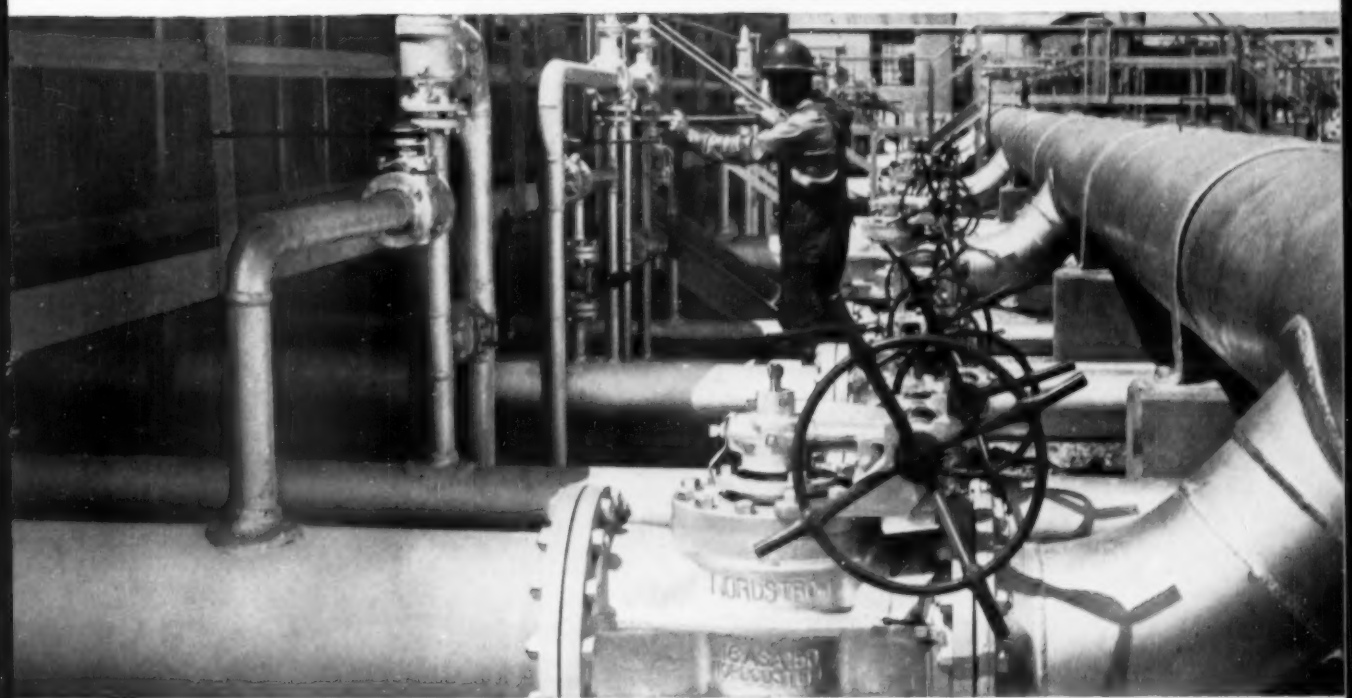
Meetings of the NACE's standing committee will be held, and the annual general business meeting of the association is scheduled for Tuesday morning, March 13. At the annual banquet on Wednesday, March 14, presentation of the annual NACE awards will be made to Mars G. Fontana, Ohio State University, Columbus, and Norman Hackerman, University of Texas, Austin. Edward L. Simons, General Electric Research Laboratory, Schenectady, N. Y., will receive the 1955 NACE junior author award.

TRANSMISSION • STORAGE • CONDITIONING

GAS

PIPELINE SECTION

ENGINEERING • CONSTRUCTION • MAINTENANCE



SAFETY on any gas service

Dependable, ROCKWELL-Nordstrom VALVES

For suction and discharge lines at compressor stations like the one shown above, or for residential meter settings—or for *any* gas service— you can't buy a safer valve than Rockwell-Nordstrom. Instead of uncertain metal-to-metal seating, Rockwell-Nordstrom valves utilize a thin, tough film of special pressurized lubricant to form a continuous, leak-proof seal. This lubricant seal is impervious to scratching and erosion. It *stays* dependably leak-proof, year after year. Lubricant also hydraulically jacks the plug for perfect seating and keeps it ready for instant, smooth quarter-turn operation.

Rockwell-Nordstrom valves will give you longer, more dependable service than any other valve you've ever used. They cost no more, often less, than ordinary valves. *Rockwell-Nordstrom valves are available at leading suppliers everywhere.* Rockwell Manufacturing Company, 400 N. Lexington Ave., Pittsburgh 8, Pa.

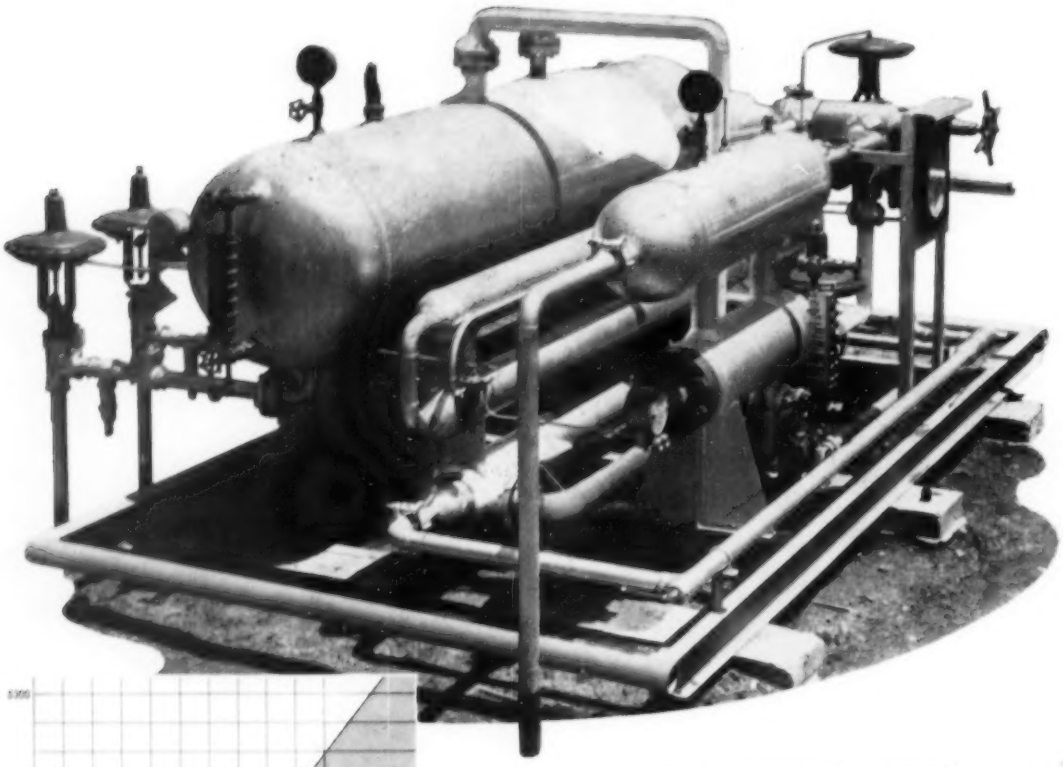
Canadian Valve Licensee: Peacock Brothers Ltd.

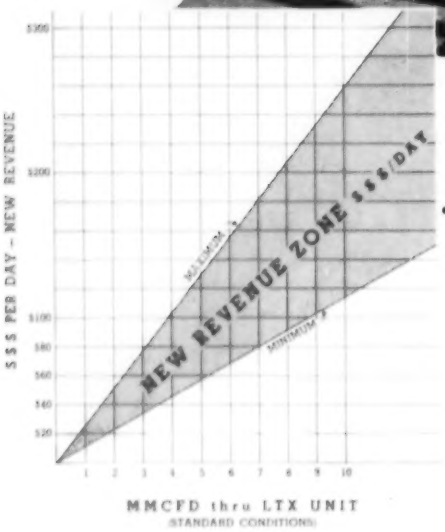
ROCKWELL-Nordstrom VALVES

Lubricant Sealed for Positive Shut-off

40th Year *of lubricated plug valve leadership*

$66.00 Per Day Added Extra Revenue With...





The increase in gross revenue to be obtained from an LTX installation is a function of a number of factors. May we have the opportunity of evaluating your prospect?

.....NATIONAL LTX*

This is the first of two 10 MMCF, 1000 psi National LTX Units set on a lease in East Texas. Production figures reveal that the well made 9 bbls. of distillate per MMCF on potential test through standard separation. After setting the National LTX, production increased to 15 bbls./MMCF. The operator flows 4 MMCF/day. This means an increase in distillate recovery of 24 bbls./day valued at approximately $66.00 or $24,090.00 per year.

* T.M. Reg. U.S. Pat. Off.

It's National

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

7-7-52

W-K-M Valves

JUST LIKE INSURANCE

W-K-M's precise control of each step of the manufacturing process insures the excellence of every W-K-M Valve. Depending upon the size and the type of the valve, there will be over 300 separate inspections made on every single valve produced in the W-K-M plant. This is your assurance that W-K-M Valves will not only meet your most rigid specifications, but will provide trouble-free service for years to come.

Receiving Inspection

Raw Castings and materials received in warehouse are inspected for conformity to dimensional specifications.

Chemical & Metallurgical Analysis

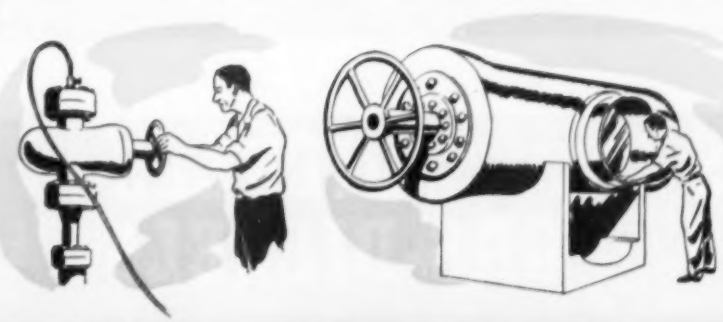
Chemical and physical tests are run to determine conformity to ASTM specifications. In the case of some high pressure valves, the castings are inspected by gamma ray technique. Many other castings and materials are checked by magnetic particle methods to assure soundness of structure.

Manufacturing Inspection

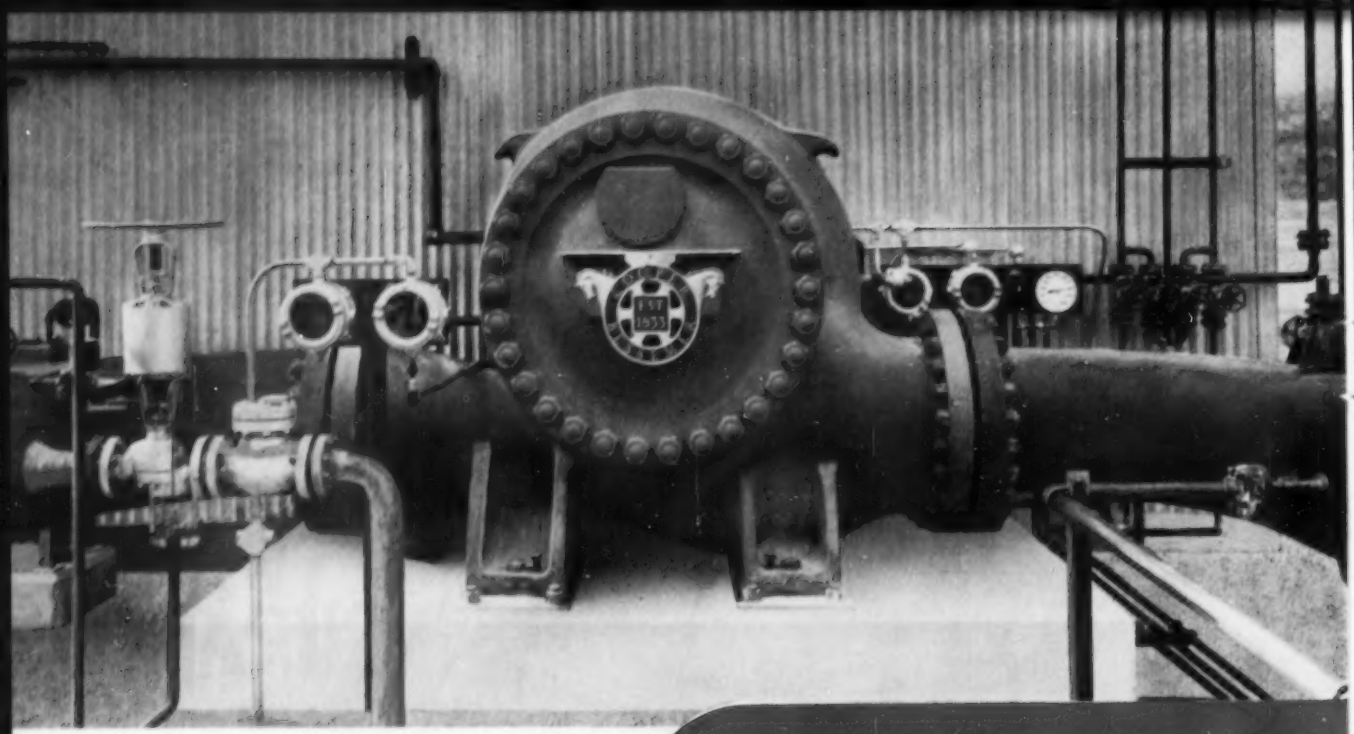
All manufactured parts inspected for dimensional accuracy and finish. Also metallurgical and physical testing procedures are applied to maintain rigid control of these parts.

Testing

All valves tested 100% on high pressure test rack to test soundness of body and sealing at both seats.

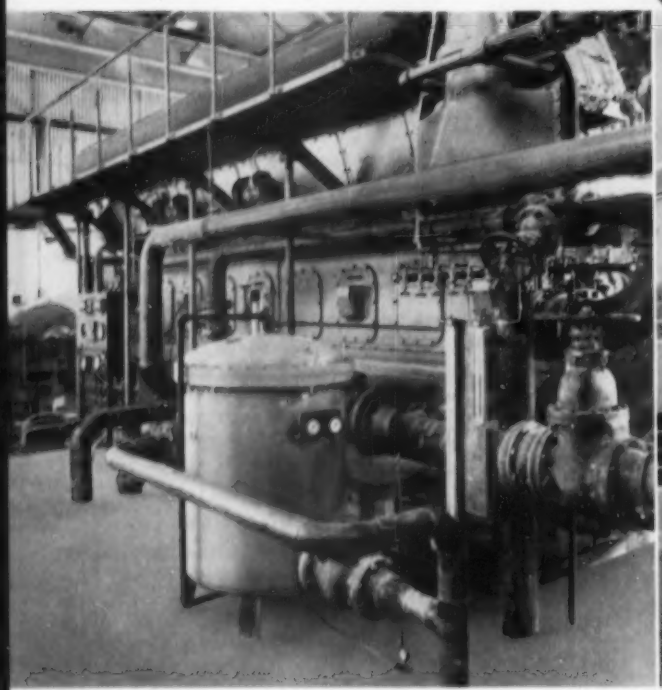


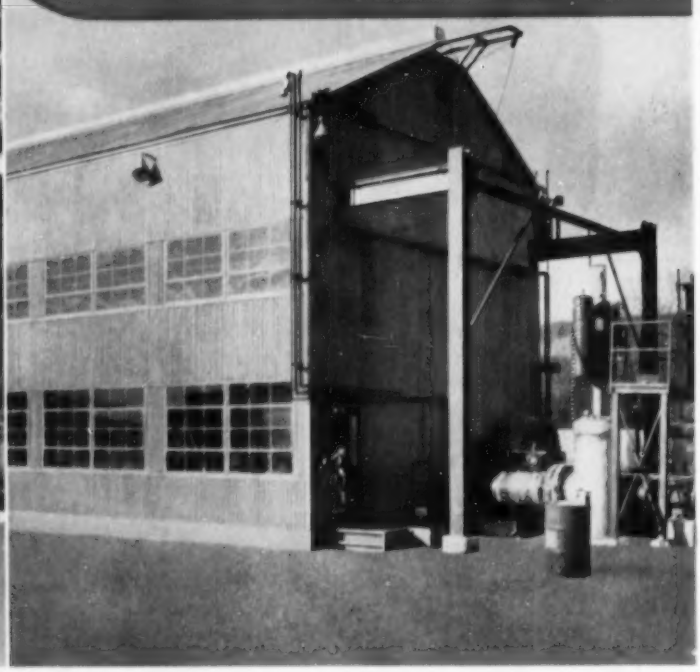
W-K-M Manufacturing Company, Inc.
A subsidiary of ACF Industries Incorporated
P. O. Box 2317, Houston 1, Texas Los Angeles, California
Export Office: 45 Rockefeller Plaza, New York, N. Y.



Cooper-Bessemer centrifugal compressor and 4-cycle gas engine, separated by fire wall, comprise unitized set-up in Gulf Interstate's new satellite station. Nominal capacity: 400 million cubic feet a day at 935 psi. Note compactness of station in view at lower right.

Cooper-Bessemer





COMPRESSORS Reciprocating and Centrifugal DIESELS
GAS ENGINES · GAS-DIESELS

Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Chicago

Another important FIRST in gas pipeline transmission

ENGINE-DRIVEN *centrifugal* COMPRESSORS

• A new chapter in the progress of gas transmission has been opened at Gulf Interstate Gas Company's new compressor station near Stanton, Kentucky. Here, a Cooper-Bessemer engine-driven centrifugal compressor, the result of long development, is the first such unit to go into regular service on a main gas transmission line.

This precedent is a tribute to Gulf Interstate management for alertness and decisive action in the application of promising new ideas . . . here successfully applied through the close cooperation of Gulf Interstate and Cooper-Bessemer engineering. These are a few of the highly significant features:

SATELLITE STATION . . . Designed and fully equipped for automatic, unattended, remote control operation—*another* "first" for Cooper-Bessemer engine-driven centrifugals.

IDEAL FLEXIBILITY . . . Combines continuous, heavy-duty performance with ability to meet peak demands. Greatly increases flexibility of line-to-market gas transmission.

EXTREME SIMPLICITY . . . Comprises a "unitized" setup not requiring separately operating auxiliaries. Moreover, the combination permits controls that cannot be matched for simplicity in satellite operation by most alternate methods.

UNMATCHED ECONOMY . . . With 41% thermal efficiency, the Cooper-Bessemer 4-cycle engine is unsurpassed in fuel economy by any other type of prime mover today. It would take 2 to 5 conventional compressor units and a much larger station to equal its capacity.

PROVED COMPONENT DESIGN . . . Actually the engine and other major components of this unitized set-up are *not new*. They are fully proved designs! It is the *combination* that sets an important precedent and brings new advantages!

Cooper-Bessemer engine-driven centrifugals offer identical or similar gains in various types of service. Additional installations are already under way. Why not discuss *your* plans with the nearest Cooper-Bessemer office?

by **Cooper-Bessemer**

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

New York City Washington, D. C. New Orleans Los Angeles and San Francisco

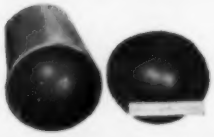
Cooper-Bessemer of Canada, Ltd.

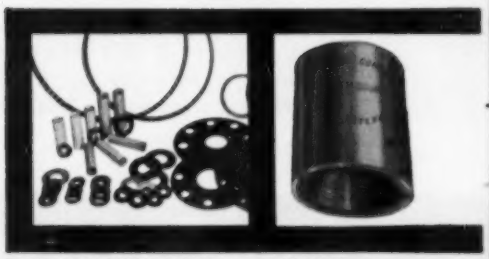
11304, 119th St., Edmonton and 615 Second St., S. W., Calgary, Alberta, Canada

Precision Products by Maloney

Since 1932

BALL TYPE SCRAPERS



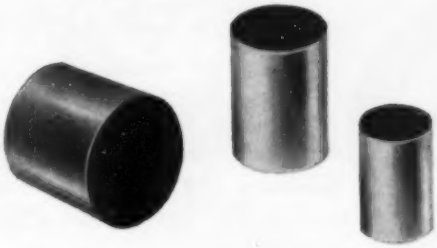


FLANGE INSULATION

INSULATED COUPLING

"Precision in

"Something From the Irishman"



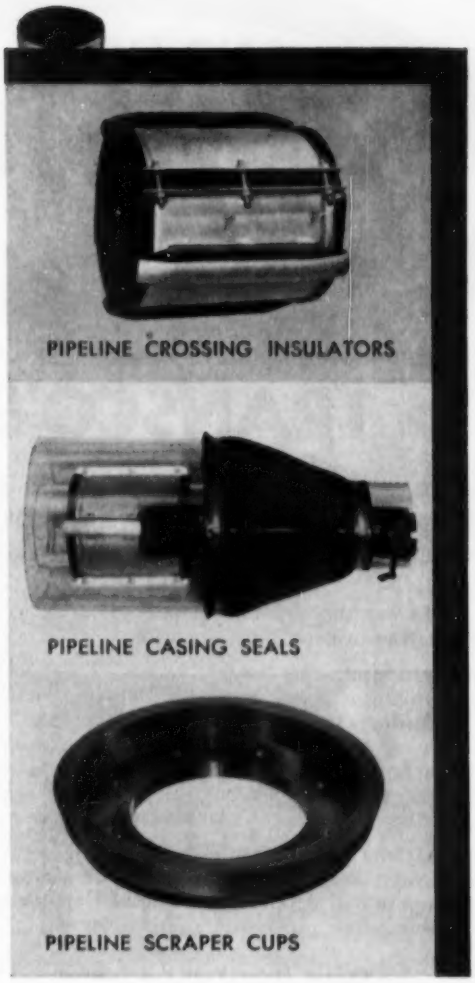
INSULATED COUPLINGS

FOR CATHODIC PROTECTION

Insulated Couplings
Flange Insulation
Pipeline Crossing Insulators
Pipeline Casing Seals

FOR PIPELINE MAINTENANCE

Bakelite 3 Piece Segmental Piston Rings
Bakelite One Piece Tensioned Piston Rings
Bakelite and Nylon Compressor Valve Plates
Bakelite and Nylon Pump Valve Discs
Bakelite, Cast Iron and Bronze Floating Rod Packing
Pipeline Scraper Cups
Pipeline Ball Type Scrapers



PIPELINE CROSSING INSULATORS

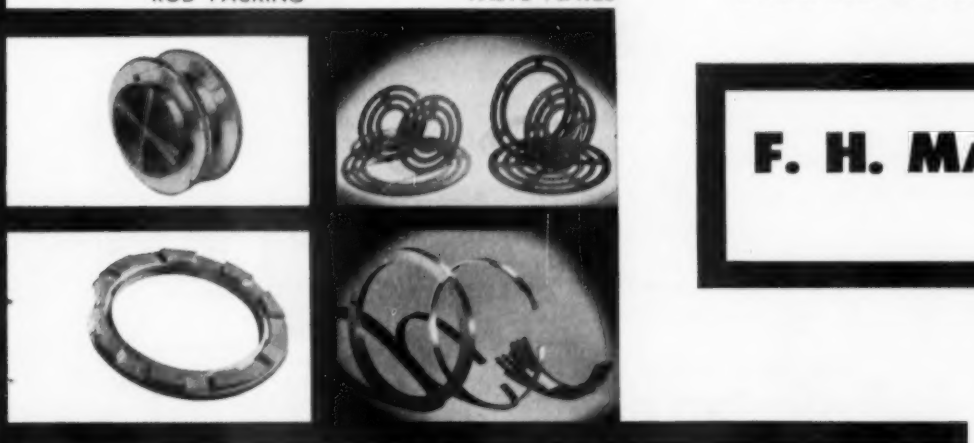
PIPELINE CASING SEALS

PIPELINE SCRAPER CUPS

SPECIALLY ENGINEERED AND MANUFACTURED PARTS IN RUBBER, METAL AND PLASTICS

ROD PACKING

COMPRESSOR VALVE PLATES



WIPER PACKING RINGS

SEGMENTAL RINGS

F. H. MALONEY *Company*

2301 TEXAS AVE.
FAIRFAX 3-3161

HOUSTON
LOS ANGELES
TULSA

Rubber, Metal and Plastics

AND NOW—

Copon

in TRANSCO'S "SUPER INCH"

Long sections of Transcontinental's new 36-inch loop are coated with Copon Internal Pipe Coating for efficient delivery of cleaner gas

Here are the simple, factual reasons why more and more transmission lines are using COPON:

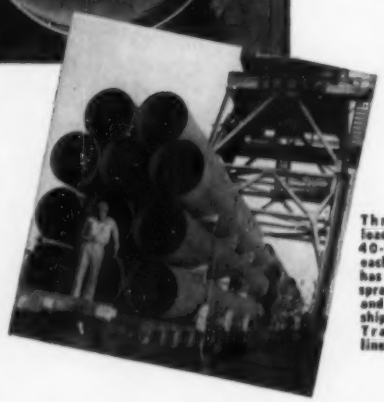
1. Proven protection against corrosion.
2. Complete internal protection of pipe during stockpiling, transportation and laying of line.
3. Reduced cost of using scrubbers and strainers.
4. Cleaner gas delivery greatly reduces maintenance and labor costs.
5. Over the years COPON saves many times its cost.

Our technicians can give your corrosion engineers, and others in your company responsible for obtaining most efficient operation, detailed evidence of Copon's exclusive characteristics.

This Coupon is for Your Convenience in Getting More Copon Facts Pronto!

Rows of 36" pipe, destined for Transco's "Super Inch" line, as it is rolled from Consolidated Western Steel Company's Orange plant to Rossen-Richards' yard where it will be chemically cleaned and sprayed internally with Copon, the effective corrosion control coating.

Close-up showing how pipe is pressure-sprayed with Copon at Rossen-Richards yard in Orange, Texas. Pipe is rotated as automatic sprayheads are slowly pulled through entire 40-foot length of pipe.



Three flat cars loaded with eleven 40-foot joints each. This pipe has been Copon-sprayed internally and is ready for shipment to the Transcontinental line.

GAS - March '56

Please send me information about COPON Internal Pipe Coating.

Name_____

Company_____

Position or Title_____

Address_____

City_____ State_____

Copon is manufactured under an exclusive franchise by the select group of companies listed below. Write the company nearest you for details.

ALLIED PAINT MFG. CO.
P. O. Box 1088
Tulsa, Okla.

ENTERPRISE PAINT MFG. CO.
2841 So. Ashland Ave.
Chicago 8, Ill.

WALTER N. BOYSEN CO.
42nd & Linden Sts. — Oakland 8, Calif.
2309 E. 15th St. — Los Angeles, Calif.

BROOKLYN PAINT & VARNISH CO., INC.
50 Jay St., Brooklyn 1, New York

HANNA PAINT COMPANY, INC.
P. O. Box 3206, S. H. Station, Birmingham 5, Ala.

COAST PAINT & LACQUER CO., INC.
P. O. Box 1113
Houston 1, Tex.

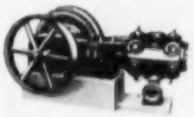
JAMES B. SIPE and COMPANY, INC.
P. O. Box 8010
Pittsburgh 16, Pa.

Heavy-duty
ES compressors

provide maximum efficiency in a
WIDE RANGE OF APPLICATIONS

. . . with unusual flexibility of drive and cylinder arrangements

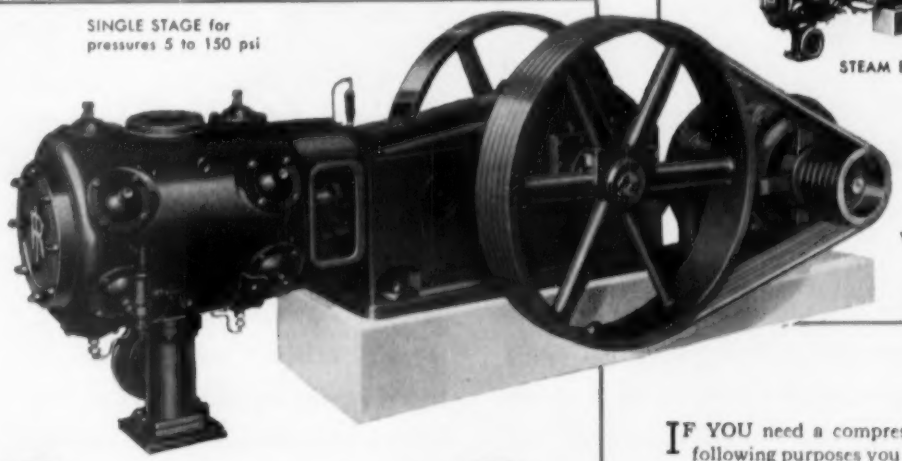
OVERHEAD MOTOR



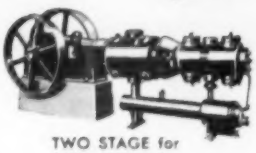
DIRECT-CONNECTED SYNCHRONOUS MOTOR

STEAM DRIVE

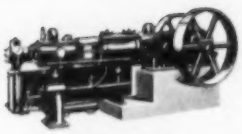
SINGLE STAGE for pressures 5 to 150 psi



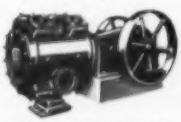
V-BELT DRIVE



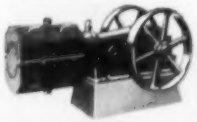
TWO STAGE for 150 to 500 psi



THREE STAGE for 500 to 2500 psi

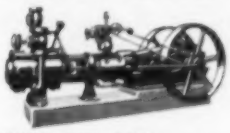


DRY VACUUM PUMPS . . . single or two stage



STEAM-PRESSURE BOOSTERS

NON-LUBRICATED CYLINDERS for oil-free air or gas



REFRIGERATION UNITS for ammonia or other refrigerants

IF YOU need a compressor for any of the following purposes you should consider the Type "ES" compressor . . . a standardized, yet extremely flexible compressor built by Ingersoll-Rand, the pioneer compressor builder.

- To compress air or gas to any pressures between 5 and 2500 psi, or for pulling vacuums. (Stock cylinders are normally available for all frame sizes, see illustrations.)
- For capacities requiring from 7½ to 150 horsepower. (Six frame sizes are available.)
- For continuous full-load operation day after day, week after week.
- For handling poisonous, inflammable, or other gases where leakage must be avoided.
- Where compressed air or gases must be free of all traces of oil. (Type NL cylinders require no oil, glycerine, grease or water for lubrication.)
- Where a future change in pressure conditions may call for a change in cylinder sizes.
- Where power cost is an important factor.
- To act as an economical standby unit for larger compressors whose full capacity is not required at all times.

Ingersoll-Rand

1-347 11 Broadway, New York 4, N. Y.

COMPRESSORS • CONDENSERS • AIR & ELECTRIC TOOLS • TURBO BLOWERS • PUMPS • ROCK DRILLS • GAS & DIESEL ENGINES

For Greatest Reliability over

it's PHILCO POWER

10 times more microwave power gives

EXCLUSIVE WITH PHILCO! Ten times more transmitter power in Philco CLR-7 Microwave systems . . . with a degree of performance and reliability never before attained in microwave equipments.

Heart of the Philco system, the "Power House" Klystron, generates a full watt of power (10,000 watts ERP) in the preferred 6000-7500 mc band.

This Philco CLR-7 Microwave power results in a received signal 10 times stronger—a higher safety margin to overcome adverse propagation conditions.

Philco CLR-7 Microwave equipment can be installed in minimum space . . . employs reliable, long-life tubes, a positive frequency control system and is completely compatible with existing wire line and two-way radio facilities *and with any type multiplex equipment.*

Get complete data on CLR-7 Microwave equipment. Let Philco help in the planning of your system. Philco maintains a staff of microwave specialists who are experienced system and field engineers. Call a Philco field representative or write Philco, Dept. G, today.

PHILCO REGIONAL SALES OFFICES

CHICAGO 11, ILLINOIS
666 Lake Shore Drive

LOS ANGELES 25, CALIF.
10589 Santa Monica Blvd.

DAYTON 2, OHIO
Talbott Bldg.

SAN FRANCISCO 3, CALIF.
1355 Market St.

WASHINGTON 6, D.C.
744 Jackson Place, N.W.

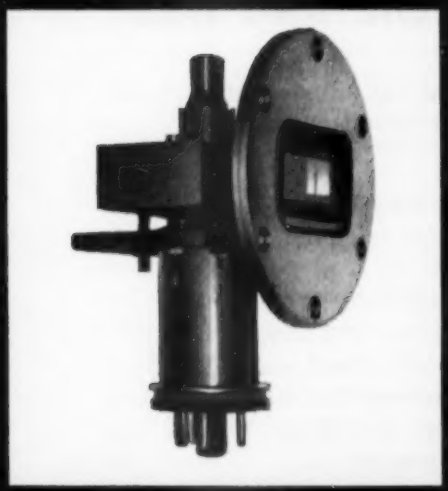
DALLAS 1, TEXAS
201 Southland Life Bldg.

the "Long Haul"

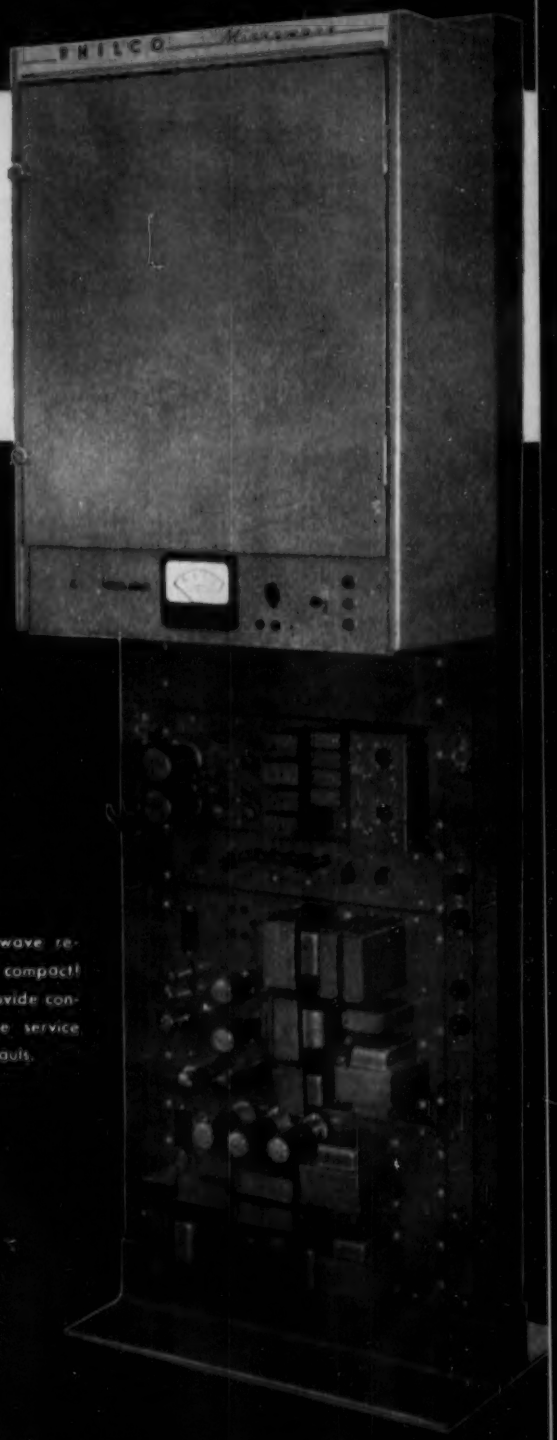
THAT COUNTS!

you advantages like these:

- 160% greater maximum hop distance
- Fewer microwave relay stations
- 10,000 watts effective radiated power—50% smaller antennas
- Reduced tower installation costs
- 10 db additional signal safety margin



Philco "Power House" Klystron provides the highest equipment power output available in the preferred 6000-7500 megacycle band.



Philco CLR-7 Microwave repeater . . . rugged! compact! reliable! Built to provide continuous, trouble free service over short or long hauls.

PHILCO CORPORATION

Government and Industrial Division

Philadelphia 44, Pennsylvania

In Canada: Philco Corporation of Canada Ltd., Don Mills, Ontario • In Europe: Philco Corporation, Paris, France.

Youngstown

ELECTRIC WELD LINE PIPE

QUALITY YOUNGSTOWN SERVICE

ROLLING TUNNELS FOR OIL AND GAS

Thousands of miles of Youngstown Electric Weld Line Pipe are now serving as tunnels for oil and gas. Synchronized sets of forming rolls shape the steel skelp into tubular form. The completed tube passes from the final forming roll through the electric welder which joins the edges in a solid continuous weld. With rigid quality control continued through the final processing operations, Youngstown Electric Weld Line Pipe is ready to become tunnels for oil and gas.

* * *

Four reasons why Youngstown Electric Weld Line Pipe is your best buy: (1) It bends readily; (2) Wall thickness is uniform; (3) Weldability is outstanding; (4) Long lengths save you time and trouble. The Youngstown Sheet and Tube Company, Youngstown 1, Ohio. Sales and service offices throughout the oil and gas producing areas.

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

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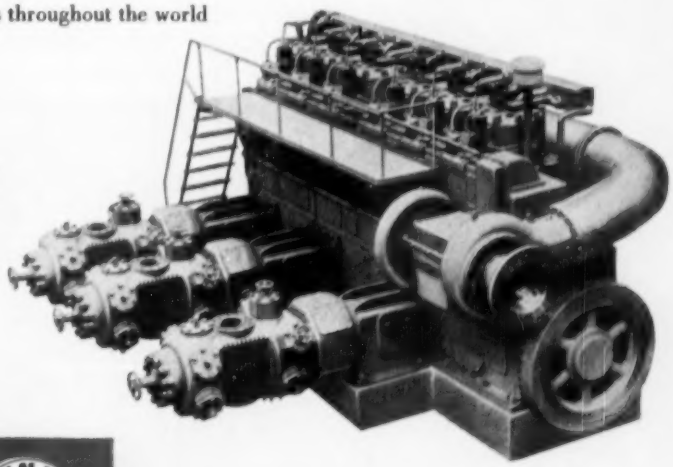

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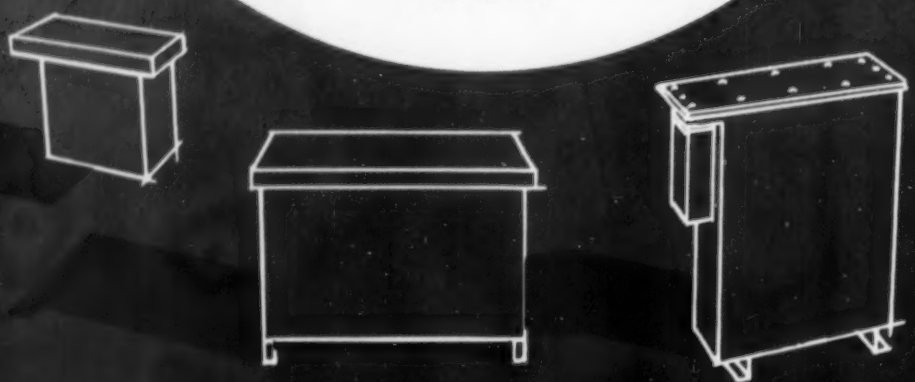

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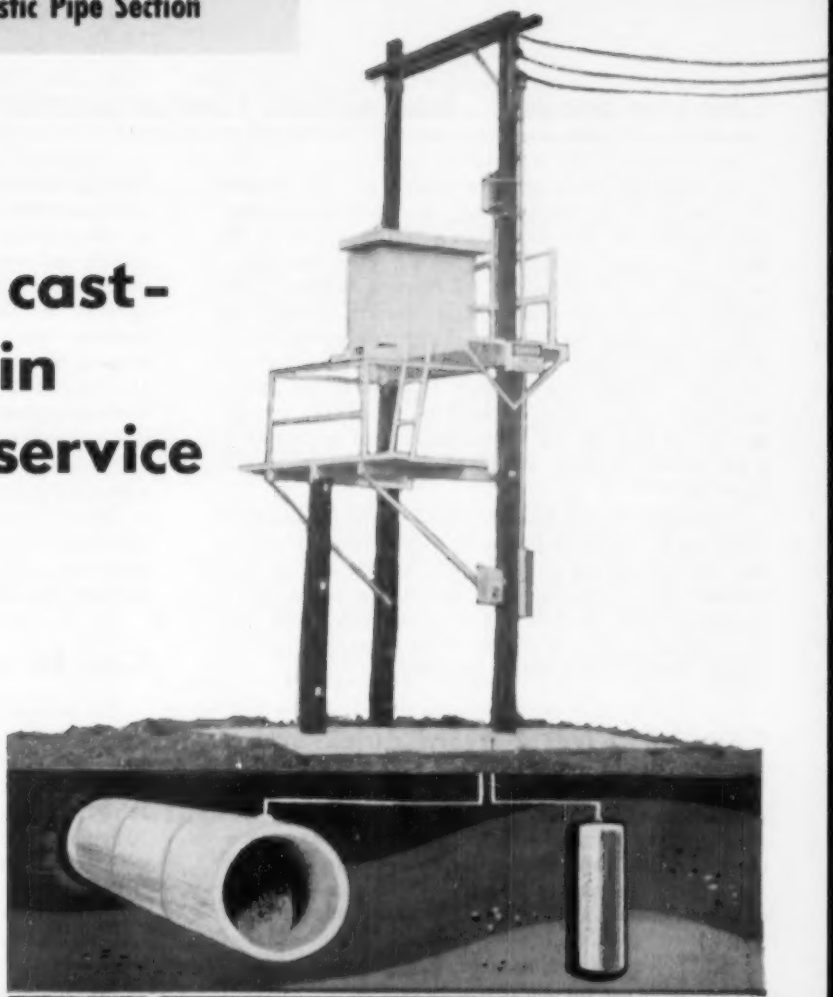
High-silicon cast-iron anodes in ground bed service



By MARSHALL E. PARKER
Consulting Corrosion Engineer
Houston, Texas

Gas industry corrosion engineers have been investigating a relatively new material — high-silicon cast-iron — for possible application as anodes for impressed current cathodic protection systems. It has been used as an insoluble anode for a variety of electrolytic processes in the past, and now an authority presents some case histories on applications to gas transmission lines.

HIGH-SILICON cast iron (under the trade name *Duriron*) has, for many years, been used successfully as an insoluble anode in a variety of electrolytic processes. The same material has also been used for corrosion-resistant pumps, valves, piping, and fittings. These two applications in combination attracted the attention of corrosion engineers to the material as a possibility for use as anodes for impressed current in the application of cathodic protection.

Experimental anodes were cast, and their use showed such promise that regular production designs were adopted and a large number of installations have been made. Three distinct fields of application have so far been developed: (1) in fresh water, where the freedom from contamination by corrosion products has led to a rapid and general acceptance; (2) in cable ducts, as individual anodes assembled on a cable pulled into place, where ease of installation (and good performance) has likewise led to widespread acceptance; and (3) as ground bed anodes in the cathodic protection of pipelines and other buried structures. It is with this last application, protection of pipelines, that the present discussion is chiefly concerned.

Historically, ground bed anodes have consisted of either (1) scrap iron or steel, which is consumed at the rate of 20 lb/amp-yr, or (2) carbon or graphite rods imbedded in a carbonaceous backfill, the consumption of which is supposed to be considerably less. In actual practice, the loss of effective anode material in scrap iron beds is frequently greater than the theoretical rate, because of differential attack which severs the elements, and leaves large segments unconsumed but disconnected.

The experience with carbon or graphite rods has, in some cases, been similarly disappointing, but usually for somewhat different reasons. The carbonaceous backfill, usually in the form of thoroughly tamped coke breeze, serves two important purposes; first, it enlarges the effective diameter of the anode, and thus reduces the resistance to earth; secondly, the coke breeze takes the brunt of the electrochemical attack due to the discharge of current, the anode rod serving merely as a means of establishing contact. If, however, the backfill is not thoroughly compacted, this latter function is not fully served; soil moisture will lie in contact with the rod itself, a part of the discharge will be electrolytic, and there will be attack.

Laboratory tests disclosed that below current densities of 5 amp/sq ft (corresponding to 10 amp per anode) there is very little weight loss on high-silicon anodes; in most electrolytes and at normal temperatures, the loss is less than 1 lb/amp-yr. Field tests have now substantiated these findings, and the number of successful case histories is growing rapidly. Three of these will be described.

Case I — River bottom quicksand

A ground bed of nine graphite anodes was originally installed at this site, supplying protection to a gas transmission line. At a depth of about 6 ft, quicksand was encountered, in which it was impossible to maintain an open hole. Accordingly, the lower part—about 2 ft—of each rod was merely pushed down into the quicksand, and only the upper 3 ft surrounded with tamped cokebreeze, to a diameter of 12 in. The anodes were arranged in a single row at 30-ft spacing; intial current output was 30 amp at 40 v (rectifier terminals), or a total loop resistance of 1.33 ohms. After a year's time, the current had fallen off to 6 amp, at which value the line was not receiving the desired protection. Examination disclosed that the lower portion of the graphite rods, which had been in direct contact with the soil, was completely destroyed; the remaining portion in the cokebreeze backfill, surrounded as it was by higher resistance soil, was incapable of performing more than a small part of the intended function of applying cathodic protection to the pipelines.

This ground bed was then abandoned, and one constructed along the same line, with a longitudinal displacement of 15 ft, using Duriron anodes (2 in. x 60 in.). These were installed in a similar manner; i.e., the lower 2 ft was pushed down into the quicksand, and the upper 3 ft backfilled. Initial current output was 20.7 amp at 39.5 v, or a loop resistance of 1.91 ohms; but during the next five months this value declined steadily, reaching a value of 1.10 ohms (34.56 amp at 37.9 v). This has remained nearly constant since then, and the bed now has a successful operating history of 13 months.

Case II — More quicksand

A scrap steel pipe ground bed in this location had been serving for several years, but differential attack had sectionalized it to the point where it was no longer capable of delivering the full amount of current needed. Soil resistivity averaged 2500 ohm-cm, measured with the four-pin method at 10-ft spacing. The water table was normally very high, and the soil was of such nature that it was practically impossible to maintain an open hole; accordingly it was decided to use Duriron anodes without any backfill. Twenty were installed, in two rows 20 ft apart, with 20-ft spacing between the anodes in each row. The anodes were installed by jetting them into place with a high-velocity stream of water through a 10-ft length of 1-in. pipe; average time to sink an anode to 9-ft depth was one minute.

The initial total loop resistance (anodes, connecting cables, and pipeline) was about 1.2 ohms, of which 0.5 ohms is credited to the pipeline itself. Subsequent readings show a progressive lowering of total resistance, most of the change being apparently located in the anode group. This anode bed now has a life record of approximately one year.

Case III — A comparison

This installation was made initially with Duriron anodes, and was designed to yield information on the value of backfill. Twenty 2-in. x 60-in. anodes were installed around a pair of oil storage tanks, the average spacing being about 25 ft. Ten of the anodes were installed bare, and the other 10 in the conventional cokebreeze backfill. Individual shunts were installed in each anode lead, so that the current output of the anodes could be determined individually. Soil resistivity at the site is quite variable, ranging from a low of 1100 ohm-cm to a high of 2800, measured at 10-ft spacing. Because of this factor, and the additional dissymmetry of the anode lead and the protected piping, there is considerable variation in anode currents. At the time of the first survey, some two months after the installation, the total current output was 45.37 amp, of which the backfilled anodes were carrying 29.03 (64%) and the bare anodes 16.34 (36%). Six months later the total current had been reduced by regulation of the rectifier voltage to a value of 25.50 amp; the backfilled anodes were found to be carrying 12.21 (48%) and the bare anodes 13.29 (52%).

After a lapse of another 10 months, it was interesting to note that this trend was continuing; of a total current of 27.77 amp, the backfilled anodes carried 11.57 (42%) and the bare anodes 16.20 (58%). There is reason to believe that the soil in immediate contact with the anodes, both bare and backfilled, is of lower resistivity than the average value measured by the four-pin method, due to the invasion of salt water; from this it would appear that there is no advantage to be had by the use of backfill in low resistivity soils, although there is an obvious gain in higher soils.

Range of application

As has been mentioned, these inert anodes have already won wide acceptance in the cathodic protection of water tank interior surfaces, because their advantages over previously used materials were large and easily recognizable. Similarly, their superior mechanical strength and corresponding ease of application (coupled with equal or superior per-

formance) have led to an increasing use in string anodes for cable protection in ducts. An examination of their properties in soil is next in order.

For the most common type of rectifier installation, on a cross-country gas transmission line, there are four possibilities to be considered; these are the four combinations of two sets of conditions: (1) "high" or "low" soil resistivity, and (2) "wet" or "dry" hole conditions. The distinction between "high" and "low" resistivity, for this discussion, is made on this basis; a soil is considered "high" if the number of anodes required is determined from the economic considerations of power consumption rather than from the maximum permissible current discharge per anode. A "wet" hole is defined to be one which either fills with water at a rate which makes proper tamping of backfill difficult, or one which caves so badly that soil inclusions in the backfill cannot be avoided; a "dry" hole is one in which it is possible to obtain a thoroughly tamped backfill column without difficulty.

Obviously, there are many factors involved in the distinction between "high" and "low" soils, as here defined—type of anode used, composition of backfill, dimensions of hole, spacing between anodes, total current output of unit, power rate, and others. The complete analysis of these factors is a complex engineering problem, but for most installations the line of demarcation lies somewhere between 1000 ohm-cm and 4000 ohm-cm. Some very special cases will be discussed briefly later.

(1) High soil, dry hole. Under these circumstances there is a premium on low resistance; and, because of the dry hole conditions, it is relatively easy to lower anode resistance by the use of backfill. High-silicon cast-iron anodes, when installed in a compacted cokebreeze backfill, do not behave appreciably differently from any other type of inert anode; resistance is the same, inherent potential is the same (being determined by the backfill), and no appreciable attack is to be anticipated on the anode itself. The only possible difference, then, is that of cost—and at present prices, this is practically the same for either the high-silicon iron or the graphite.

(2) Low soil, dry hole. Here again, if installed in the same way, with cokebreeze, there will be no appreciable difference in either performance or cost between graphite and high-silicon iron anodes. However, it may be possible to use the iron anodes without backfill; the resistance of a *single* anode thus installed is about 2.5 times that of a backfilled anode; but when groups are involved, the mutual interference is less, so that for 10 anodes, for example, the ratio is only about 1.5 to 1. This means that in many cases additional anodes can be installed with the money saved by the omission of backfill, with the same total resistance; or, a bed can be operated at a slightly higher resistance, with the increased power costs being absorbed by the savings in initial investment; or, the minimum power bill may be such that the higher resistance ground bed, although using more power, does not actually cost any more. All of these possibilities should be anticipated, and calculations made to evaluate the savings possible.

(3) Low soil, wet hole. This combination of circumstances is overwhelmingly in favor of the high-silicon iron anode. It may be installed without backfill, and in many cases can simply be pushed into place; water jets have been used successfully. The higher resistance per anode imposes no penalty in low resistance soil, since the number of anodes which must be used for a given current value brings the total resistance down to a value which is often below the minimum power bill.

(4) High soil, wet hole. In these conditions, a larger number of bare anodes must be installed to obtain an economically low resistance, as compared with backfilled anodes. If the decision is to use backfill, then there is no appreciable difference in cost or performance; if the decision is to omit backfill, then the high-silicon anodes afford the only choice, and the question must be resolved by economic considerations. An analysis is necessary for the final choice, and the difference is seldom very large in either direction.

Actually, the discussion above is an over-simplification of the problem; the difficulties of properly tamping backfill under wet-hole conditions are so great that the usual result is a very inadequate job, with the inevitable result (with graphite anodes) of shortened anode life. The alternative to this unsatisfactory state of affairs is the use of a temporary or permanent casing, with accompanying increased cost. The statement that there is no appreciable difference in performance between the two types of anodes considered must be qualified by saying that this refers only to *properly compacted backfill*; if an inadequate job is done, then the performance of the graphite anodes will suffer, while the only penalty incurred with the high-silicon iron will be that of the unnecessary added expense of the backfill.

Special Cases. There are some exceptional cases, alluded to above, where other factors enter into the decisions to be made. Any exhaustive treatment of these would be, necessarily, prolonged to the point of boredom, so only casual mention of a few will be made:

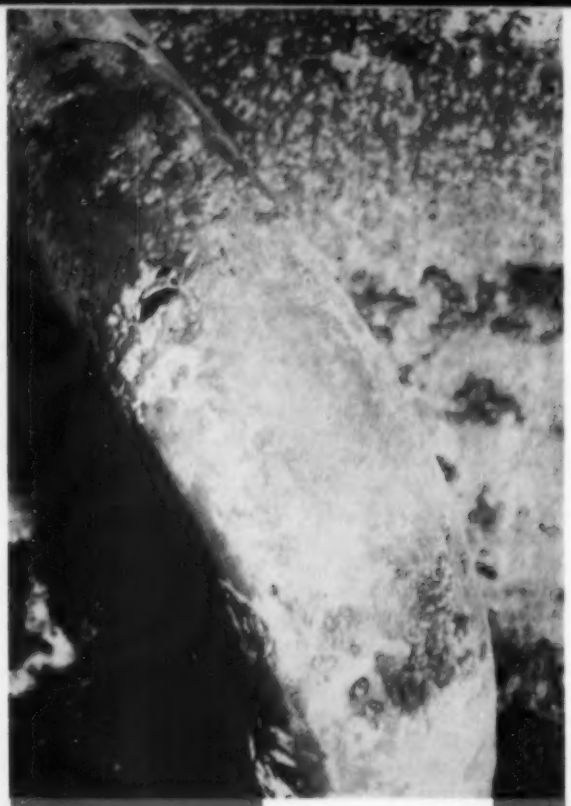
(1) In areas of difficult accessibility, or regions remote from normal sources of supply, the freight costs of backfill are often so high that the use of bare anodes is economical, either with the increased number required or the larger power bills.

(2) Where small current values are drained by individual units (such as with distribution systems or gathering systems), the minimum power bill is often such that the higher resistance ground bed obtained with anodes without backfill does not result in any higher power costs; and only the high-silicon iron anodes can be used successfully without backfill.

(3) Where there are available only highly restricted low-resistivity areas, it may be necessary to so compress the ground bed into the available space that the choice of materials becomes irrelevant.

Conclusions

The inescapable conclusion, when the performance of high-silicon cast-iron anodes is compared with that of conventional types in a wide variety of conditions involving application in soil, is that either (1) there is no essential difference in cost or performance between the two, or (2) the advantage lies markedly with the high-silicon iron anode. Therefore, it must be concluded that savings are to be had by stocking the high-silicon iron anodes exclusively, and using them in all applications; some of these will show savings, and none of them will show losses. ■



GASOLINE PLANT CORROSION

With more and more natural gas companies operating extraction plants and natural gasoline plants each year, the vexing problem of corrosion in these processes become of increasing concern to the gas industry. Corrosion in gasoline plants is usually due to the presence of carbon dioxide—the experience gained in combating this type of corrosion in condensate wells has been applied to lick this problem.

By EDWARD C. GRECO, Research Department

United Gas Corp., Shreveport

GAS exclusive

CORROSION has been with us for a very long time. Since man first learned to reduce the metal ores to useful materials we have had the destruction of equipment by corrosion and the accompanying loss of money and life.

Corrosion can be dangerous to life as well as cause loss of money and equipment. This is particularly true when high pressure equipment is involved. In gasoline plants there are a number of large high pressure vessels which are subject to corrosion. Since corrosion usually occurs from the inside where it is not readily apparent, all high pressure vessels should be looked on with suspicion. *Do you know if your plant is corroding?*

What is corrosion? It is presumed that everyone has fixed in his mind some definition of the phenomena which is the result of this thing called corrosion. Funk and Wagnalls' dictionary defines corrosion as "an eating or wearing away; gradual decay; specifically, the destructive breaking down of metals into their oxides or metallic salts." Therefore, corrosion might be defined as the process by which a metal reacts with its environment resulting in its deterioration or destruction.

The damage caused by corrosion is usually readily apparent. When surface attack occurs, the thickness of the metal is reduced and the surface of the metal is visibly affected, appearing roughened, etched, pitted or covered with a corrosion product.

Although it is relatively simple to recognize the damage caused by corrosion, we are sometimes at a loss to explain how it has taken place and what precisely is causing it. Fortunately, today there is information and experience upon which we can rely to assist us in solving some of the corrosion problems in oil and gas production equipment.

For more than 10 years the NGAA corrosion research project committee has studied corrosion of gas condensate wells. This committee discovered the causes, explained in part the mechanism, and found methods that are presently being used to control condensate well corrosion effectively and economically. About two years ago, the condensate well corrosion committee was reconstituted into the plant corrosion committee. Now this committee is actively engaged in studying corrosion in gasoline plants and other gas handling equipment.

Corrosion in gas condensate wells is of the acid type. The primary agents responsible are carbonic acid (resulting from the solution of carbon dioxide in water) and organic acids. Water is necessary for corrosion to take place. As the pressure on a system increases more carbon dioxide goes into solution and the solution becomes more acid. From the work on condensate wells it was established that at 100°F and a carbon dioxide pressure of one atmosphere

(14.7 psi) a pH of 4.0 can be obtained. This means that at a total gas pressure of 1000 psi a concentration of carbon dioxide of 1.5 mol % will produce a pH of 4. At this pH, corrosion of steel takes place readily. Even if the carbon dioxide content of the gas is only 0.8 mol %, at 1000 psi a pH 4.3 is possible. Corrosion in gasoline plants is mainly owing to carbon dioxide. In some plants, where the gas has been compressed from a pressure below atmosphere, oxygen may be a factor, but in the majority of cases carbon dioxide is responsible. What effect a small amount of hydrogen sulfide has on this system has not been determined.

Since corrosion by carbon dioxide in condensate wells is so well understood, it is surprising that very little information can be found in the literature on corrosion of gas gathering systems or gas processing equipment. This is particularly true of gasoline plants where corrosion is usually due to carbon dioxide. In a survey conducted in 1952 by the California Natural Gasoline Association, it was reported that 31% of the gas-handling systems in the 300 to 450-psi pressure range were found to be severely corrosive. However, of those in the 500- to 700-psi range, 75% were reported to be severely corrosive, indicating that the incidence of corrosion goes up with an increase in partial pressure of carbon dioxide.

For corrosion to take place water is required. From observation of several systems handling high pressure gas it appears that the amount of free water controls the corrosion rate. Therefore, corrosion must be suspected in any system where an appreciable amount of water and a sufficient partial pressure of carbon dioxide is present.

Recently, corrosion has been observed in gas gathering systems and in certain vessels in gasoline plants. The corrosion has always been associated with water and a high partial pressure of carbon dioxide. In the gathering system, the corrosion has been found in the bottom third of the pipe and in sags where water accumulates and stands. Penetrations of 50 to 75% of the wall thickness in eight years have not been uncommon.

In several plants in the east Texas area corrosion has been found and reported in the following vessels:

1. Absorbers.
2. Steam stripping stills.
3. Rich oil still reflux partial condensers.
4. Rich oil still final condensers.
5. Depropanizer condensers.
6. Fin-fan cooler partial condenser.
7. Reboiler bundles on diethanizer, depropanizer, and disobutanizer.
8. Preheater in the dehydration cycle.
9. Still overhead accumulator.
10. Debutanizer reflux accumulator.
11. Depropanizer reflux accumulator.
12. Deethanizer reflux accumulator.
13. Reactivating gas coolers.
14. Return steam condensate system.

It is not within the scope of this article to discuss corrosion in each of the above vessels. However, corrosion in absorbers and the steam stripping stills and certain other units will be described as typical examples.

In one plant, three absorbers were inspected from top to bottom. Two of these, absorbers A and B, plant A, have been in operation eight years while the third, absorber C, plant B, has been operating for five years. Each of the vessels operate at a pressure of 1050 psi, an oil circulation rate of approximately 150 to 220 gpm, and a gas rate of 40 to 50 MMcf per day. The gas contains 0.80 mol % of carbon dioxide or a carbon dioxide partial pressure of 8.4 psi. Under these conditions, the pH of the water in the system is estimated to be about 4.5. The lean oil to the absorber carries approximately 756 gal. of combined and free water per day.

In general, the corrosion in absorbers A and B, plant A, was about the same. The cast iron bubble caps on trays 1 to about 9 were graphitized, indicating graphitic corrosion. Graphitic corrosion usually occurs on cast iron where the ferrite is dissolved and the carbide remains. There was very little graphitization of the bubble caps on the bottom section of the tower, but risers were generally more severely corroded. The nuts on the bubble cap anchor bolts showed signs of electrolytic corrosion. A number of the carbon steel risers were completely corroded away and some were heavily pitted because of electrolytic action between the cast iron cap and low carbon steel riser. Pits from 50 to 350 mils deep were found in the wall of the absorber behind the spill plate. The corrosion was always deepest in this area of the absorber wall. It was estimated that in these two absorbers, 14 to 16 percent of the wall had been penetrated.

On several of the trays, the welded section immediately below the spill plate was deeply corroded at a point where the tray joins the shell. This was a "rut" type corrosion 350 mils deep directly into the weld seam and the adjacent tray metal. The top surfaces of the trays were pitted to a depth of 300 mils. The rich oil discharge line in the bottom of the absorber was completely penetrated at several points. There was general corrosion on the bottom of the vessel and pits 200 mils deep were found. *Fig. 1* shows the rich oil discharge line in the bottom of the absorber.

In absorber C, plant B, the corrosion pattern was somewhat different from that in absorbers A and B, plant A. There was very little wall corrosion, but trays, risers, and bubble caps were heavily attacked. The interior of this absorber was covered with a heavy, soft deposit, which, when analyzed, was found to be mostly ferrous carbonate, the corrosion product of iron and carbon dioxide. Nine trays were completely penetrated (see *Fig. 2*). Seventy risers and 1560 pressed steel bubble caps were badly corroded and had to be replaced. Five spill plate weirs were corroded to the point where replacement was necessary.

The corrosion in these high pressure absorbers is due mainly to excess water in the lean oil and carbon dioxide from the rich gas. The carbon dioxide, which is present in the incoming gas, forms carbonic acid, which attacks the iron. The quantity of water influences the corrosion rate. A critical ratio of water to oil exists above which corrosion is expected. This ratio may be defined as that concentration of water which wets the surface of the metal.[1] It is believed that this condition exists in absorbers A, B, and C, described above.

In order to determine the effect of water on the corrosion rate, a plant was found operating in the same area with gas from the same field as plants A and B. The absorbers in this plant have been in operation for five years and conditions of operation are very nearly the same as those found in plants A and B with the exception that the lean absorp-

[1]Shock, D. A. and Sudbury, J. D., Corrosion Control in Gas Lift Wells, *Corrosion* 10, 9, p. 299 (1954).

tion oil and rich gas stream are both dehydrated before reaching the absorbers. One of these absorbers was selected and inspected from top to bottom. No evidence of corrosion could be found on any part of the interior. The walls, trays, and risers were covered with a very uniform, thin, hard, adherent black scale. From observations in this absorber there is no doubt that the removal of water from the absorber oil had eliminated the corrosion in this vessel although all of the other factors necessary for corrosion are still present.

Corrosion in steam stripping stills has been noted in the still reflux tank, condenser outlet headers and on trays and walls in the upper section of the vessel where water condenses out. The major source of this water is the condensing stripping steam injected into the bottom of the still. The carbon dioxide is brought into the system mainly from the absorber and released from the oil during the stripping operation. Upon condensation, the water dissolves the carbon dioxide forming carbonic acid, which attacks any metal with which it comes in contact. No corrosion has been found in the trays below the feed tray.

In one still inspected recently, the pressed steel caps on the upper 12 trays were corroded out completely. There was no corrosion below the 12th tray from the top, but the first two trays above the feed tray were almost plugged with a ¼-in. thick deposit of iron oxide.

Severe corrosion has been reported on the trays and walls in the reflux section of the still in a gasoline plant operating in Illinois.[2] Corrosion in this plant has been treated with an organic type inhibitor (Kontol 118) for about five years with very good results. It is reported that the inhibitor is being injected into the gasoline reflux line at a rate of 6 ppm.

A plant in east Texas reports that caustic (sodium hydroxide) has been added to the overhead vapor line and the hydrocarbon reflux line back to the still. By adding 6 lbs. of sodium hydroxide per day per still, a pH of 6.8 is maintained on the water at the water draw-off. This procedure has been in effect for 18 month and has reduced the iron content of the water drawn from the water draw-off from 12 ppm down to 2 ppm. This may not sound imposing, but since the caustic treatment, there have been no leaks in the steam condensate return system whereas before it was necessary to repair it once a week. The corrosion

[2]Uhl, William C., *Petroleum Processing*, Vol. 7, p. 196, 1952.

Fig. 2. Complete penetration of absorber near area of riser.

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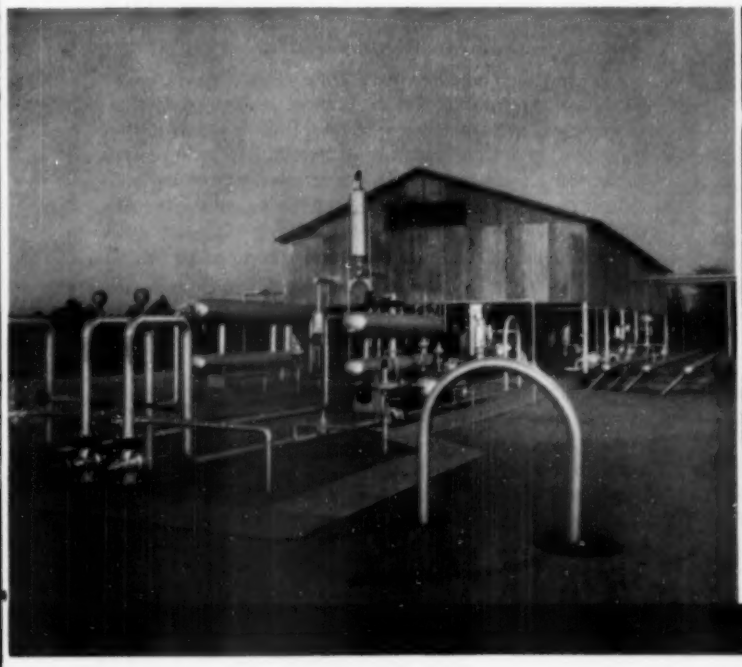
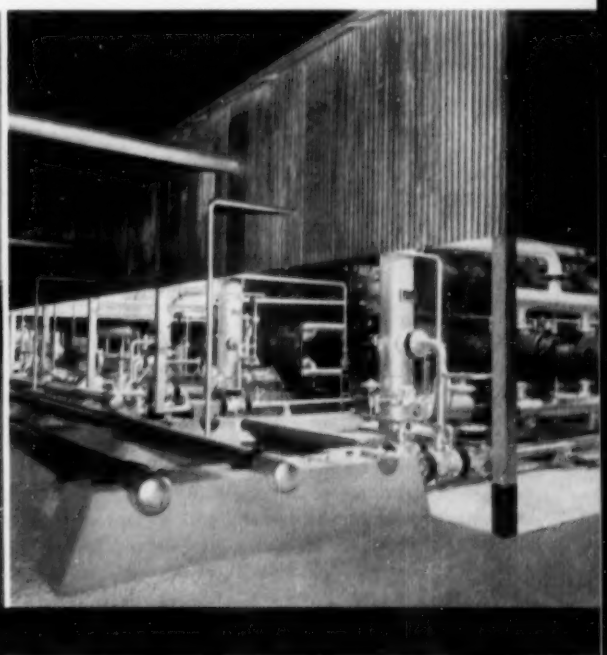
Originally designed with piping and connections for additional units, the station added the second compressor, a 440 h.p. Beaird 8SVG, when new wells were tied into the station. The third, a 660 h.p. Beaird 12SVG, was installed when wellhead pressures dropped and two-stage compression became necessary. At present only the largest and one small unit are needed, but as the pressures drop still further all three will be used to follow the suction on down through final production stages.

Fully automatic and designed for unattended operation, the station has required no increase in personnel to handle the added units.

Let us show you how packaged compressors can provide the most economical means of enlarging your present compressor station.

R. E. SMITH CARTHAGE FIELD COMPRESSOR STATION—equipped with three Beaird-Ingersoll-Rand gas engine driven packaged compressor plants, Young radiators and all necessary controls. Beaird packaged compressor plants are available in a range of sizes from 110 to 660 h.p.





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PACKAGED COMPRESSOR PLANTS

CAST STEEL FITTINGS

PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP-GAS SYSTEMS

of the threads around the brass plugs in the cast iron reflux condenser header has also been entirely eliminated.

In a paper presented at the regional NACE meeting in Dallas Bryant W. Bradley of Shell Oil Co., reported that his company has been treating the still reflux tank and condenser outlet headers with 15 ppm of soda ash (sodium carbonate) for over three years also with very good results. The iron content of the water in the reflux condensers dropped from 34 down to 10 ppm and the failure frequency of the condenser outlet header decreased abruptly. Before treatment the condenser outlet headers required replacement about every five months. There have been no replacements since the beginning of soda ash injection.

TABLE 1. COMPARISON OF AUDIGAGE AND MICROMETER MEASUREMENTS ON STEEL SPECIMENS OF VARIOUS THICKNESS

	Thickness in Inches			%
Specimen No.	Micrometer	Audigage	Error	Audigage Error
1	0.142	0.142	0	0
2	0.250	0.253	+.003	+1.2
3	0.258	0.258	0	0
4	0.298	0.301	+.003	+1.0
5	0.330	0.329	−.001	−0.3
6	0.517	0.519	+.002	+0.4
7	0.806	0.817	+.011	+1.4
8	0.991	0.997	+.006	+0.6
9	1.086	1.105	+.019	+1.7

Another company in east Texas injected boiler blowdown, which is alkaline, and has a pH of 11.1 to 11.5, into the following process vessels in order to inhibit corrosion:

1. Still overhead accumulator
2. Debutanizer reflux accumulator
3. Depropanizer reflux accumulator
4. Deethanizer reflux accumulator
5. Absorber

However, this treatment has been discontinued because the large amount of dissolved salts in the boiler blowdown caused plugging. An organic-type inhibitor has been substituted with good results.

A gasoline plant in east Texas has tested an organic-type inhibitor. Both the oil soluble and water soluble forms were used to protect the inlet scrubbers, absorption system, still and condensate system. Because of emulsion difficulties the use of these inhibitors was discontinued.

A corrosion control program was initiated in a cycling plant in Texas three years ago. A survey had shown serious corrosion in the stripper and still systems, recycled gas systems, and in the ethane and propane fractionation system. A number of inhibitors were tested and in over two years of continuous testing two organic inhibitors, Corexit 50 and Kontol 118, were reported to be equally effective.

Several organic compounds such as Kontol, Corexit, Nalco, Polyrad, Visco, Corban, Nocor, etc., have been used with varying results in gasoline plants.

There are both advantages and disadvantages to using organic and inorganic-type inhibitors. The organic inhibitors, if not selected carefully and used properly, will form emulsions. When organic inhibitors are used in a vessel in a gasoline plant, the condition of the system must be considered. If the system is coated with scale and other debris and the inhibitor is injected in excessive quantities, emulsions are likely to form. In a dirty system the inhibitor must be diluted and injected at a very low rate until all the scale and debris has cleared out. Emulsions are more likely to form in a dirty system than in one that is clean. Finely divided corrosions products appear to stabilize the emulsions.

Inorganic alkaline inhibitors, such as sodium hydroxide and sodium carbonate, also have the disadvantage that they will attack admiralty metals if not controlled properly. At a pH of 8, dezincification of admiralty in the presence of an alkali will occur. However, very large amounts are required to obtain a pH of 8 with sodium carbonate or hydroxide in a carbon dioxide water system where there is virtually an unlimited amount of carbon dioxide. From work done on condensate well corrosion it was found that above 2000 ppm (17 lb per 1000 gal.) of sodium carbonate is required to raise the pH from about 5 to 7.5 at a temperature of 130°F and 0.5 atmosphere of carbon dioxide.[3] To reduce the possibility of attack on admiralty metal, refinery operators have found that a pH of 7.5 must not be exceeded. In gasoline plants, corrosion control has been obtained at a pH of 6.8. Therefore, when alkalies are used the pH in the system must be carefully controlled.

Two methods have been described which can be used to determine corrosion and also evaluate corrosion control methods without shutting down the plant. These are iron determinations and Audigage surveys.

The first method—borrowed from refinery operations—consists of determining the iron content of the water drained from vessels in various parts of the plant. By determining the rate of water and quantity of iron, it is possible to calculate the amount of iron lost from a vessel per day. By critical use of this method it is possible to determine precisely in which vessel corrosion is taking place and with the Audigage the exact points of corrosion can be located.

The Audigage is a sonic instrument which measures metal thickness by means of frequency vibrations. This method has been employed by Shell Oil Co. in evaluating corrosion and corrosion control in its gasoline plants. *Table 1*, which is taken from Mr. Bradley's paper, illustrates the accuracy of the Audigage.

By combining these two methods with visual observations it is possible to determine which vessels should be suspected, where corrosion protection should be applied and, after protection is applied, to determine the effectiveness of the control methods. ■

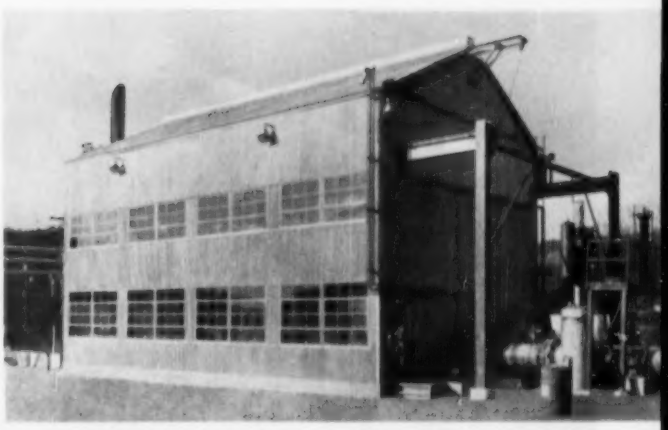
3*Condensate Well Corrosion*, NGAA, Tulsa, Okla, 1953.

ACKNOWLEDGMENTS

The author is indebted to these following companies for much of the information contained in this article: The Chicago Corp.; The Carthage Corp.; Arkansas Fuel Oil Corp.; United Gas Corp.; and United Gas Pipe Line Co. I especially wish to thank Messrs. Crowl of The Chicago Corp., Dorsett of The Carthage Corp., Wallace of the Shell Oil Co., Shepherd of Arkansas Fuel Oil Corp., and Loker and Trainor of United Gas Pipe Line Co., for their assistance.

SATELLITE

compressor station goes on mainline service



Gulf Interstate mainline station near Stanton, Ky., where first engine-driven centrifugal compressor was placed in mainline service.

First fully automatic engine-driven centrifugal compressor designed to operate unattended by remote control.

THE gas pipeline industry's first centrifugal compressor driven by a fully automatic four-cycle gas engine is operating on mainline service for the Gulf Interstate Gas Co. The unit is installed in a satellite compressor station near Stanton, Ky., with facilities for operating unattended by remote control from another compressor station 80 miles away in Clementsville, Ky. Designed as a completely unitized installation, the unit operates entirely on its own auxiliary accessory equipment.

A Cooper-Bessemer Type LSV, 16-cylinder, 4-cycle gas engine, which delivers up to 4550 hp, drives the centrifugal compressor through a speed increaser. The engine is spark-ignited, supercharged, and equipped with turbocooling, enabling it to operate at fuel economies of slightly over 6000 Btu/bhp-hr.

The centrifugal compressor is capable of handling over 500 MMcf of gas a day at discharge pressures up to 950 psig.

Turbocooling utilized

Turbocooling is utilized for manifold intake air. By means of expansion cooling of intake air through a unique turbo-blower system, it has become possible to substantially increase the air-fuel charge to the engine. Resulting increases in horsepower are accomplished without corresponding increases in heat load on the engine itself. With expansion turbocooling, manifold air intake temperatures are reduced without the high consumption of water as on conventional systems, a particular advantage where water is restricted. Turbocooling is a development of the Cooper-Bessemer Corp.

Gulf Interstate's Stanton station is designed to handle large volumes of gas to act as a booster for meeting peak demands during winter periods by partially unpacking the line. During normal periods, the heavy duty engine-driven centrifugal unit operates as a conventional compressor.

Satellite station control

The actuation of Gulf Interstate's satellite station can be controlled by direct wire. Equipment is provided for opening and closing line valves, starting the engine, cutting the engine-compressor into the line, controlling engine speed, for setting station discharge pressures, cutting the compressor off the line, and shutting down the engine. Essential operations are telemetered to the main station. Sight and sound alarms signal any malfunctioning on main control panel at Clementsville and, where necessary, automatically shut down the unit.

Starting procedure

To start Stanton station's automatic engine-driven centrifugal compressor unit, controls initiated at the Clementsville panel first open the line suction valve. The blowdown valve is normally open when the station is off of the line.

After a period, the blowdown valve is closed and the line pressure builds up in the compressor case. The discharge valve closes, actuating a permissive start switch to energize the engine starting circuit. Simultaneously, engine auxiliaries (such as the oil circulating pump) are all initiated to circulate oil from the gear sump of the speed increaser through a gear oil heater.

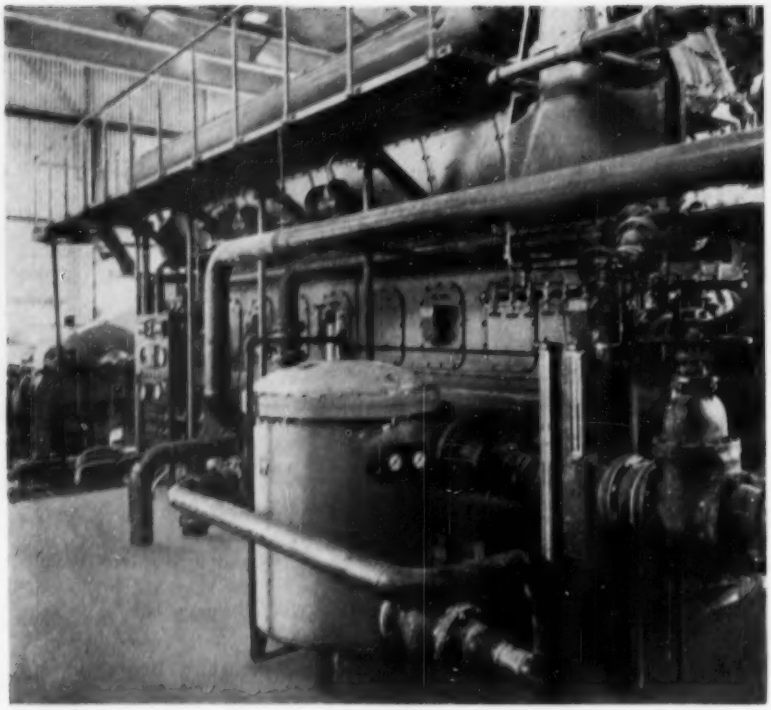
Oil level maintained

The oil level is automatically maintained in the seal oil tank for the centrifugal compressor shaft seals. In event of low oil level, additional oil is automatically diverted from the gear sump.

Only when all auxiliaries are properly functioning and line valves correctly set can the main start switch actuate the engine-starting circuit.

Engine-starting sequence

Pushing the start switch button at Clementsville station initiates the engine-starting sequence by energizing the automatic control circuit of a 3-way air-solenoid valve to admit starting air to the engine. After the engine picks up speed and runs for a set purge period, the ignition is turned on. The fuel gas safety shutoff valve and starting fuel valve are then opened, admitting fuel to the engine. Only after the engine gains and reaches partial speed does the engine speed control switch



Interior view of Gulf Interstate's satellite compressor station showing the four-cycle, supercharged, 4550-hp, gas engine that powers a centrifugal compressor (not shown) on the other side of fire wall.

energize the control circuit of the main fuel gas valve. At the same time, starting air is shut off, and the main fuel valve opens.

At the partial engine speed, gas pressure is admitted to the diaphragm of a 3-way valve in the control air line to a shutdown cylinder on the gas regulating valve and to a pneumatic link in the governor control mechanism. With the gas-regulating valve in operation and control air pressure on the pneumatic engine governor, the engine idles through a warm-up period. After warm-up, engine speed is regulated to a pre-set value by an automatic timer.

Once the engine is running at speed, line valves are opened in proper sequence to load the engine. The line discharge valve opens first. The line suction valve is then opened. Discharge pressures set on the control board at Clementsville are maintained automatically through the engine speed governor. Discharge pressures are varied by regulating engine speed.

Shutdown sequence

Pushing the "stop" button at Clementsville sets up the shutdown sequence. The main fuel gas solenoid is de-energized, closing the main fuel valve. The safety fuel gas valve then is closed. As engine speed drops down, line suction valves and discharge valves are closed. The ignition is grounded, shutting off the engine. When suction and discharge valves are fully closed, the blowdown valve is opened blowing down the compressor.

Shutdown alarm devices

Shutdown safety devices sound the alarm and turn on a look-out light at both Clementsville and Stanton stations. The devices shut down the engine, close the side gate valves and blow down the yard piping.

When shutdown is initiated by a break in the pipeline or fire in the supervisory or main building, the engine can be restarted only at Stanton. Malfunctions that shut down the engine but permit restarting at Clementsville are: over-speed of engine, low oil pressure, high discharge pressure and high temperatures.

Safety devices provided

Safety devices are provided to sound alarms at both Clementsville and Stanton but not shut down the engine in the event of loss of fuel gas heater pilot (which shuts down only the fuel gas heater); low oil level; loss of water pump seals; low water level; low air pressure, and low seal oil level.

Trouble lights indicate loss of a-c power, loss of REA power, gas surge in centrifugal compressor, variation in discharge pressure of 5 psig offset values, loss of telephone lines.

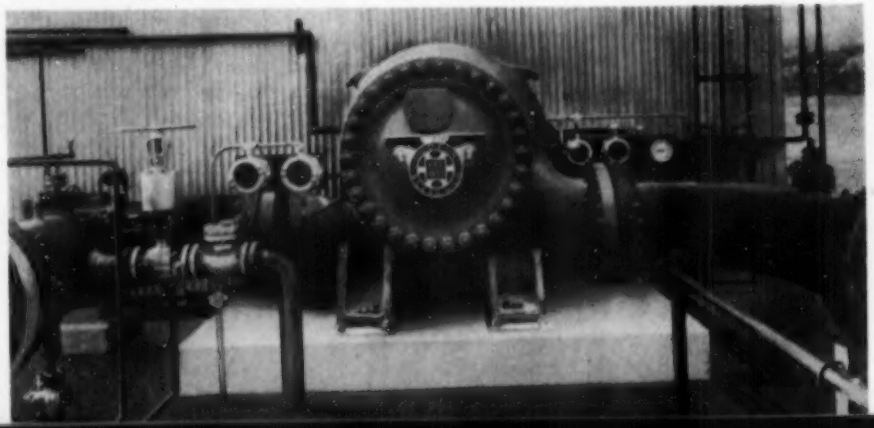
Functions telemetered to Clementsville are variation in suction pressure, discharge pressure or starting air pressure; variation in engine rpm and setting in discharge pressure controller.

Manual operation possible

In addition to start up and shut down from the remote station in Clementsville, Stanton station can be operated manually if desired. A complete switch panel is available to perform manual starting, with or without electric power from the REA system, which is the lone source of supply to the station itself.

The development of the automatically controlled engine-driven centrifugal compressor unit is a joint accomplishment of the Gulf Interstate Gas Co. and the Cooper-Bessemer Corp. ■

Centrifugal compressor (engine driven) installed at the completely automatic station. It is capable of handling over 500 MMcf/day at up to 950 psig. Gas engine is located inside building on the other side of fire wall shown.



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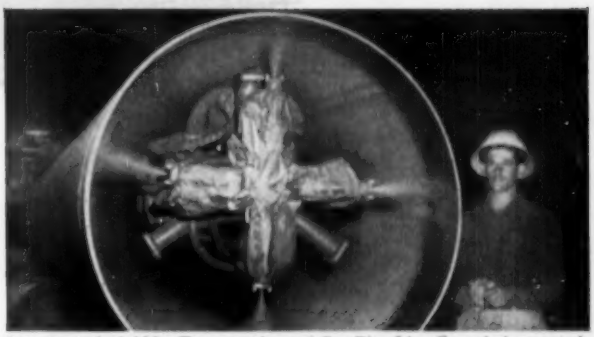
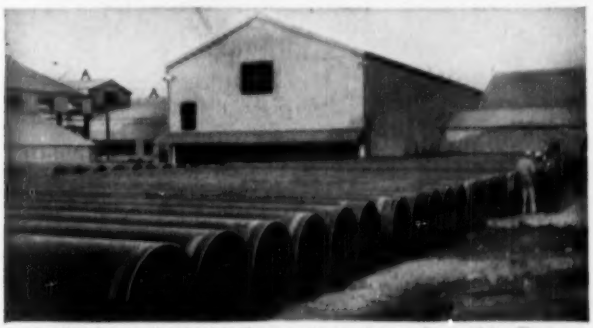
New Internal Coating *protects pipelines against corrosion by crude oil, salt water, gas*



36" pipe to be laid by Transcontinental Gas Pipe Line Corp. being coated with *Copon*, containing Epon resin. *Copon* is manufactured by Coast Paint and Lacquer Co., Houston.



Stock of 36" pipe, lined with Epon resin coating, to be used by Transco.

HERE'S HOW...

INTERNAL CORROSION of gas pipe lines has long been a costly maintenance problem. The solution is an Epon resin coating that stands up to corrosives, that does not flake or peel off, that can be readily applied.

Such an Epon resin-based enamel is now going to work in nearly 300 miles of line for Transcontinental Gas Pipe Line Corp.

It's a *one-coat*, amine-catalyzed system which, cured at atmospheric temperatures, gives the performance of many baked finishes never before obtained with any other cold-cure coating. The Epon resin liner has complete adhesion to metals and extreme resistance to corrosion that keeps gas free of rust and pipe scale.

If you need a paint that lasts longer, that has excellent adhesion, resistance to abrasion and impact, ability to withstand a wide range of temperatures, humidity and corrosive atmospheres . . . ask for *Epon resin coatings*. Call on our sales offices for names of suppliers. Write for the full Epon coatings story in the brochure, "Planning to Paint a Pyramid?"

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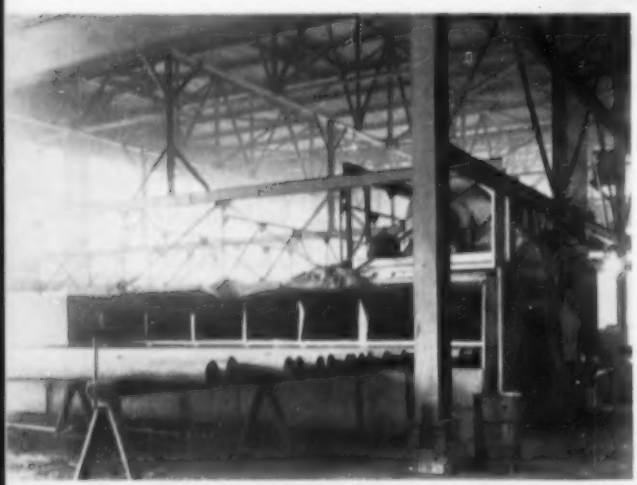
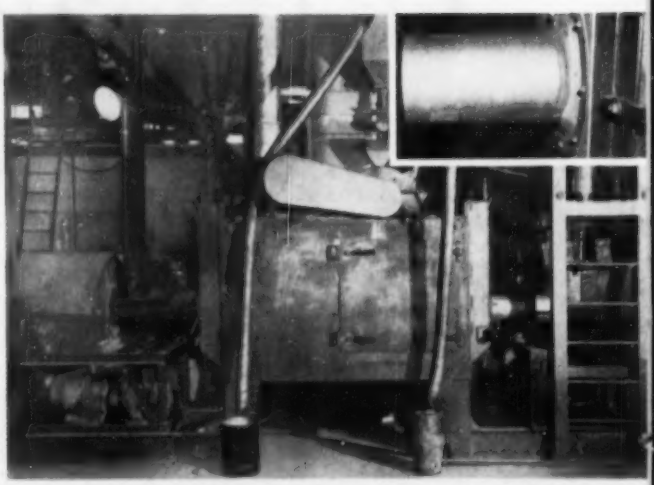
GAS VISITS A NEW COATING YARD

Out in Provo, Utah, Pipe Line Service Corp.'s new coating and wrapping mill has gone into service. Since it is one of the newest yards, GAS takes you on this pictorial visit to the facility.

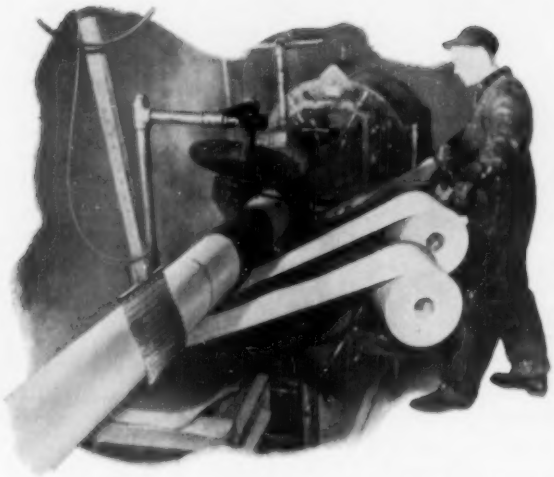
Bare pipe is unloaded at the plant and placed in an individual stock account prior to release for coating and wrapping.



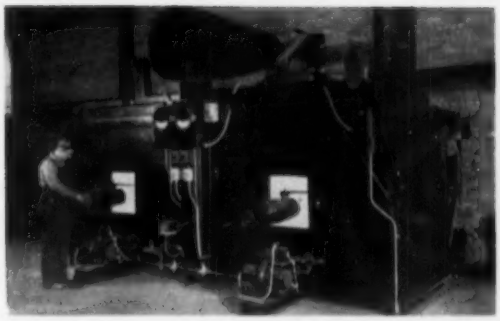
Prior to the cleaning operation, pipe is subjected to a constant blast of hot dry air in specially designed ovens to drive off surface moisture and properly condition pipe surface temperatures for good primer penetration, bond and coverage—the first step in obtaining well bonded coatings for enduring protection. (Oven curtains partially open to show oven interior.)



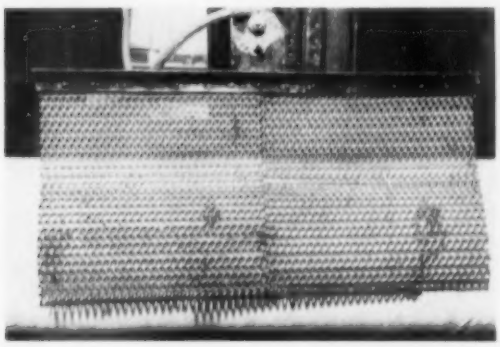
Immediately after the drying operation, pipe is propelled through the steel shot cleaning machine and primed immediately thereafter. This cleaning method is most thorough in removal of rust, mill scale and other tightly adhered foreign matter. A stippled pattern is produced on the pipe surface to help bond the coatings. Primer is applied by rotation of pipe through a specially designed priming rug in tandem.



After allowing proper drying time, the primed pipe is spirally propelled by positive drive heads, and hot coatings, wrappers and kraft paper are simultaneously applied. Pipe then passes under the electrical inspection grid. This positive movement of the pipe insures constant coating thicknesses, freeness of air bubbles in the applied coatings, even lap and smoothness of wrappers, and complete electrical inspection of the finished product to insure a void-free coating.

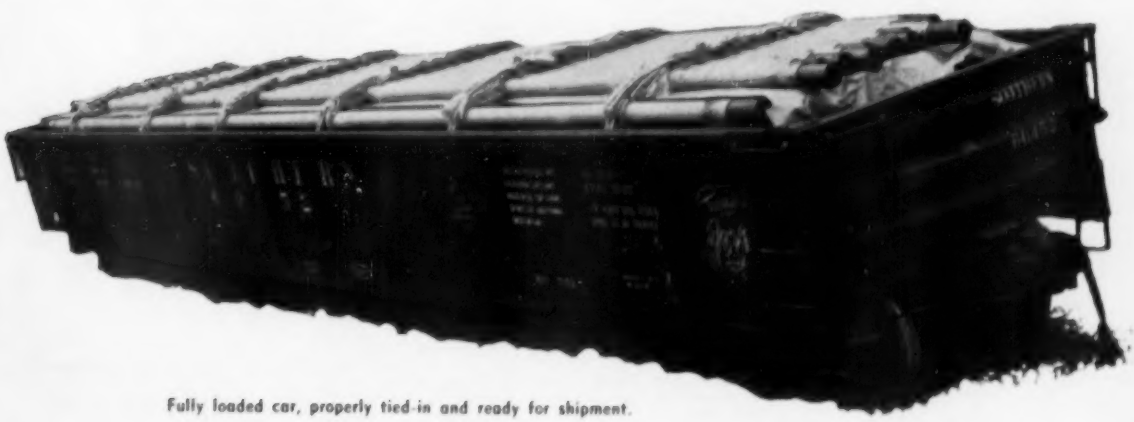


All coating materials are melted in these thermostatically controlled, firebrick-lined, gas-fired kettles producing an even heat, thus eliminating possibilities of overheating and coking of materials by direct heat application. To further insure retention of designed physical properties, the materials are constantly agitated to prevent fillers settling out.



This constantly charged, flexible steel grid applies the inspection voltage as the coated and wrapped pipe is carried past the stationary grid with a forward spiral movement.

The finished product is loaded into specially prepared rail cars to insure arrival of the coated pipe on the job site in the same void-free condition it left the plant. Several wood cradles are cut to fit car and load size. These are padded with excelsior on the pipe side. Steel strapping, on the reverse side, is then inserted. The coated pipe is snuggly cradled into position and covered with a weather-proof kraft. Several joints of pipe are then loaded atop this paper to secure its position enroute. Padding is then applied to the topside of the load and steel strapping is secured tightly to bind the load into a single unit.



Fully loaded car, properly tied-in and ready for shipment.

Lessons learned from measurement of full well steam gas

By L. G. CABLE and JOE E. ESKEW JR.
La Gloria Oil & Gas Co., Falfurrias, Texas

THE problem of gas measurement in general is complex because of the many variables involved. It becomes even more complex when we are confronted with the measurement of full well stream gas, which means in the majority of cases the measurement of high pressure wet gas.

There are many theories and practices in existence today pertaining to this problem, some very technical. It is our intent to approach the measurement of full well stream gas, and some of the problems that effect good gas measurement, from a practical standpoint.

The main reason for full well stream gas measurement is that when combined with a gpm test, it is the most economical means to measure both gas and liquid from a well, where several wells are producing into a centralized separator station or processing plant.

During the period of reservoir cycling, accurate or good wet gas measurement was not of particular importance in some plants because all residue gas was injected into reservoirs that were being cycled, and the only actual gas disposed of was that used for fuel. With the introduction of sales of large volumes of natural gas to transmission lines delivering gas to the northern and eastern parts of the country, and to industry moving to the areas of unlimited fuel supply, the necessity for accurate gas measurement became more important.

Measurement of well stream gas has, of course, been satisfactorily accomplished by the separation of gas and liquid at each individual well, metering each individually, and recombining the liquid and gas before going into the gathering system. The equipment necessary to do this results in a very expensive operation if several wells are involved.

Correct measurement, within the limits of industrial practices, of full well stream gas or wet gas is possible by orifice meter measurement through conventional meter runs. Full well stream measurement in this manner presents some problems, most common of which are:

1. Hydrates forming in the meter.
2. Liquid collection in the meter.
3. Pulsating flow.
4. Fluid condensing in the meter run and damming up in the upstream section of the meter run.
5. Obtaining correct wet gas gravities.

With the exception of an accurate wet gas gravity, the effect of the problems stated above in most cases can be minimized, or removed entirely, by installing the measurement equipment as near the wellhead as possible so that the maximum temperature and pressure present at the wellhead can be used to prevent the liquid drop out that ordinarily occurs when pressure and temperature are decreased from wellhead conditions.

The ideal situation, from the standpoint of measurement, is one where the proper temperature and pressure exist at the point of measurement such that all liquid being metered is in the gaseous phase. The only point where these conditions could exist in a wet gas gathering system is at the wellhead.

A typical wellhead measurement installation is one where the meter run comes directly off the wellhead with no choking or restrictions upstream of the orifice fitting. All flow control or choking equipment in an installation of this kind would occur downstream of the meter run.

This article is adapted from a talk presented before NGAA southern regional meeting, Oct. 28, 1955, at Shreveport.

With this ideal situation in mind it would appear that if wet gas were metered at the wellhead, measurement would be no different than conventional dry gas measurement. This is frequently the case. However, anyone who has had experience with gas well production and wet gas measurement knows that in the case of partially depleted gas wells, low deliverability wells that flow erratically, extremely high gpm wells, and others, the ideal conditions of pressure and temperature do not always exist, and some fluid is produced as such at the wellhead; therefore, the problems mentioned earlier that effect good wet gas measurement must still be reckoned with.

Because of the mild climate in the southern area, little trouble from hydrates will occur if proper operating practices are exercised. In this area, with the exception of low deliverability wells, most wellhead flowing temperatures are high enough that when the orifice meter is mounted so that the meter, orifice fittings, meter leads, and a part of the meter run are enclosed in an insulated meter house, enough heat radiates from that part of the meter run inside the house to prevent hydrates from forming.

An examination of our hydrate expectory curves shows that as the pressure increases the point of hydrate expectancy is approached. For example, no hydrates will form with a 0.600 gravity gas at 60°F and 600 psig, but if the pressure on this same gas were 1000 psig, hydrates would form at 60°F.

Since most full well stream gas is measured at a relatively high pressure, the potentiality of measurement error because of hydrate formation is always present.

The effect that hydrate formation in the meter body has on measurement depends upon the location of the hydrate formation. Hydrate formation around the float linkage, or in the pressure-tight bearing will lock the differential in one position, thus indicating a constant differential and the meter will not pick up any change in actual differential. Hydrate formation blocking the meter leads will cause the differential pen to over-range or ride below zero, depending upon which meter lead is blocked, and in either case considerable error is caused. With experience the presence of hydrates can be detected by

Continued on page 160

DIRT-LADEN RAW GAS TO CLEANER →

CLEAN GAS TO USERS →

Blaw-Knox low-height gas cleaners solve a space problem

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They provide all the advantages of conventional oil-bath Blaw-Knox Gas Cleaners plus low height for space saving and lower initial cost. Capacity ratings are the same as Blaw-Knox standard Cleaners.

Photograph shows a 24″ diameter Blaw-Knox low-height Gas Cleaner which is only 71″ high over-all. Low height was very desirable in this installation because it saved on construction costs of the building to house the cleaner and the pressure regulators.

Blaw-Knox Gas Cleaners installed at town border and district regulator stations will protect the meters and regulators from dust erosion. By keeping dust from entering the distribution system, they also eliminate complaints due to dirty gas . . . thus insuring good public relations.

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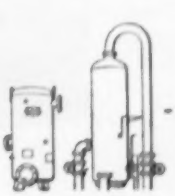

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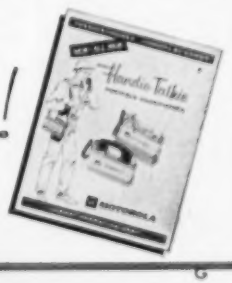

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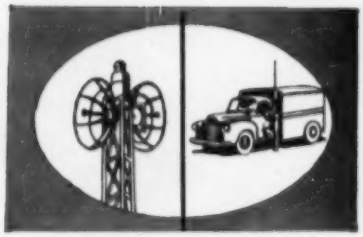

By FRANK CHAPMAN

Communications engineers invent device to aid microwave path survey

AN ingenious aid for surveying a proposed pipeline microwave path has been devised by D. R. Wofford, communications superintendent for Texas Gas Transmission Corp., and his staff of engineers. The device was designed to determine the exact heights to which it will be necessary to erect the towers that will be a part of the company's new Kentucky-to-Louisiana microwave system.

The unique device consists of an air gun that projects a powder-filled flashbulb skyward, and a special firing device that causes the powder to flash at any predetermined height. The flash is fired into the sky from a proposed microwave tower location at night and observed from a temporary tower at a second proposed tower location.

Originators of the idea, along with Mr. Wofford, were Assistant Superintendent Bill Bryant, Engineers Ed Mullikin and Pat Horne, and Radioman Bob Thomason.

The air gun consists of a 7-ft length of 1.5-in. pipe which acts as the gun barrel, a tripod for holding it in a vertical position, a piece of 6-in. pipe, a quick opening valve, a pressure gauge and a high pressure bottle of carbon dioxide. The device is fitted together with the valve between the piece of 6-in. pipe and the barrel.

To fire the gun, carbon dioxide is made to flow from the high pressure bottle into the 6-in. holding tank. The quick opening valve between the holding tank and the barrel serves as a trigger. When it is opened, pressure in the holding tank is released and the "projectile" containing the powder-filled bulb is blown from the barrel.

The projectile is a 10-in.-long piece of pipe, of a diameter that fits into the

Bob Thomason coordinates survey teams via mobile VHF radio as John Johnston awaits word to "fire" the air gun-flash device.

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Right: Engineer Ed Mullikin, Communications Superintendent D. R. Wofford, Assistant Superintendent Bill Bryant and Engineer Pat Horne are the idea-men behind the device.

gun barrel. The upper end cointains a socket for the flash bulb and the center holds two capacitors which store current for firing the bulb. The lower part of the projectile holds a coil of string which controls the height at which the bulb flashes. One end of the string is fastened at the gun's location and the other end to an insulator-type in the projectile. As the projectile rises the string plays out. When the limit of the string's length is reached the insulator is pulled out, closing a circuit between the capacitors and the bulb and causing it to flash.

Standard photographers' flash bulb is "supercharged" with enough black powder to enable observation of the flash from 35 miles or more at night. Projectile (above right) used with device. String coiled around lower end determines height at which supercharged flash bulb will be flashed. This one is set for 330 ft. Carbon dioxide from high pressure bottle (lower right) is used to load holding tank on gun. Quick opening valve serves as trigger. Released CO_2 pressure throws projectile into air. Heights to 500 ft are practical.

When the device was first tried it was found that the light of an ordinary bulb could be seen for only a few miles. Experimentation showed, however, that by making a hole in the top of the bulb and adding a quantity of flash powder, a flash of sufficient brightness to be seen 25 miles or more could be made.

Although actual flights of the projectile have been held under about 350 ft, it has been tested to heights as great as 500 ft.

The microwave tower survey is being carried out as the initial step in the construction of a multi-channel system paralleling the Texas Gas pipeline system. ■

Continued from page 154

examination of the chart especially if the examiner is familiar with the producing characteristics of the well involved.

When a meter freeze up does occur the meter can usually be cleared by releasing the pressure and the hydrates will melt. If the hydrates do not melt immediately, allow the meter to set under atmospheric conditions for a few minutes and the hydrates usually dissipate.

The problem of hydrates is easily controlled if a source of heat is available to keep meter and meter leads warm. If natural heat is not available, as mentioned earlier, it is sometimes possible to induce artificial heat in meter houses, such as electric heating coils, where power is available.

The problem of fluid in the meter body can be held to a minimum by preventing leaks in the meter manifold, piping, manifold valves, and especially pressure-tight bearings. Theoretically, the only time flow occurs in the meter leads is when the meter is pressured up and placed into service. This in itself deposits some fluid in the meter body. If a leak in the meter or manifold occurs, it will cause flow of wet gas in the meter leads and condensation of fluid in the meter body resulting in an error in the differential reading. A meter that has fluid in the upstream pot will read low. With the exception of extreme fluid condensation, this differential error (which is constant at any differential range with a given amount of fluid) can be corrected by zeroing the meter under its respective operating pressure.

Systematic zero tests will also tend to correct any differential error due to the change of this fluid level in the meter that may have occurred since the meter was last tested. This is done by most meter men at least once weekly. In cases of extreme fluid condensation, the fluid will have to be removed from the meter as there is a limit to the amount of correction possible with the mechanical zero. It is also a good practice to periodically clean the meter pots and mercury, remove any liquid, and check the meter calibration. In most cases the frequency of this service is set by contract or operating agreement, usually quarterly; however, experience will indicate if more frequent service is necessary.

The problem of pulsation in full well stream measurement is usually attributed to intermittent liquid production. This condition exists in wells having a high liquid content, and wells whose deliverability is low or whose flow rate is so low that liquid drops out in the well tubing, builds up, and is produced as one slug of liquid. In most cases, these examples exist in wells producing from partially depleted reservoirs, or from large annular area casing completions. In some cases, where a well might flow with these characteristics at low rates, pulsation can be eliminated by increasing the flow rate. This is dependent upon the individual well. Under these conditions of flow, an accurate chart reading is very difficult to obtain. This chart reading can be improved by sizing a meter run so that a high beta ratio and a high differential are obtained. The high beta ratio and high differential do not actually alter the pulsation flow, but do reduce the width of the record differential such that some of the guess work on where to calculate the chart is removed.

The conditions that can cause pulsation also can cause the more serious er-

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ror of fluid building up in the upstream section of the meter run.

In wells where the ideal conditions of pressure and temperature discussed earlier do not exist, and liquid is present in the liquid state in the well effluent, some liquid will drop out and dam up in the upstream section of the meter run. This condition results in the gaseous part of the well effluent passing through what amounts to a reduced ID meter run. This effect will produce a low differential reading because the beta ratio existing in the meter run partially filled with fluid is higher than the ratio used in calculating the coefficient. A meter run sized to produce a high beta ratio and high differential will minimize this error except in cases of extreme fluid build up. Some experimenting has been done with the eccentric orifice plate to alleviate this condition. The principle of this plate is to install the orifice flush with the bottom of the meter run, thereby providing a free exit for the liquid to pass through without the damming effect.

Unlike the concentric plate, which has been the subject of exhaustive test work, resulting in highly accurate emperical coefficient data, the eccentric has no published emperical coefficients. A usable, reasonable accurate coefficient can be calculated however, by using a curve developed by L. K. Spink and the emperical coefficient for the same size concentric orific plate.

The resultant coefficient is higher than the concentric plate coefficient by 0.5% to 3.5%, depending upon the beta ratio and Reynolds number involved. The principal objections to the eccentric plates are the difficulty in machining the plate and the extreme care necessary to install the plate properly.

We should look forward to the further development of eccentric orifice coefficient calculations so that the use of these plates, where necessary, could be advocated in contracts and gas gathering agreements.

Wet gas gravity

The determination of the gravity of a gas that contains no liquid can easily be accomplished by measuring that gravity with a gas balance.

This method, however, is not possible with wet gas because of liquid condensing in the balance when the sample is introduced. When this occurs, we no longer have a representative gas sample in the balance and at the same time an error may be introduced by liquid depositing on the float, thereby changing the balance point.

The most accurate means of obtaining a correct full well stream gravity is from a fractional analysis. This is accomplished by calculating the molecular weight of the well effluent and comparing it to that of air (see *Table 1*).

Most gas gathering contracts however, require that gravity be obtained periodically—usually monthly or quarterly. If a large number of wells were involved and a fractional analysis necessary in each case, it would be both expensive and time consuming to determine the full well stream gravity by this method.

The most practical method of determining a full well stream gravity and one that is widely used is from the calculated formula found in the Texas Railroad Commission Back Pressure

Formula:

$$\text{Sp Gr} = \left(\frac{G_e + \frac{4591\ G_1}{R_e}}{1 + \frac{1123}{R_e}} \right)$$

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Where:

G_e = Residue gas gravity

G_1 = Sp Gr of condensate

R_s = Gas liquid ratio, cu ft/bbl

Example:

Test handbook. The information required is:

1. The gas liquid ratio of the well.
2. The gravity of the liquid.
3. The gravity of the corresponding residue gas.

TABLE 1.

	Mol Fraction	Molecular Weight	
C_1H_4	92.42	16.042	14.826
C_2H_6	4.23	30.068	1.272
C_3H_8	1.62	44.094	.714
C_4H_{10}	.38	58.120	.221
C_4H_{10}	.52	58.120	.302
C_5H_{12}	.22	72.146	.158
C_5H_{12}	.14	72.146	.101
C_6H_{14}	.47	86.172	.405
	100.00		17.999

Molecular weight of Gas = 17.999
Molecular weight of Air = 28.966 = .621 Specific Gravity

$$\text{Sp Gr} = \left(\frac{0.620 + \frac{4591 \times 0.7467}{116{,}660}}{1 + \frac{1123}{116{,}660}} \right)$$

$$= \frac{0.649}{1.0096}$$

$$= 0.643$$

The data necessary to calculate this wet gas gravity can always be obtained from the periodic GPM Test data. This testing is required of all wells producing wet gas into a common gathering system for the purpose of allocating liquid production and not for the sole purpose of wet gas gravity determination.

No attempt will be made here to enlarge on the published information on deviation from Boyles Law. It is advised, however, that calculations be made to determine the accuracy of the critical temperatures and pressures established for each particular gravity.

In the higher gravity ranges, it is possible to have several hydrocarbon mixtures that will result in the same calculated wet gas gravity but have different critical temperatures and pressures. This will naturally affect the Fpv factor. The critical temperature and pressure for any mixture can be accurately calculated from a fractional analysis. This is important in that the flowing conditions under which most full well stream measurement occurs fall in the higher super compressibility factor ranges.

All of the problems of full well stream measurement are by no means solved in this article and it is realized that other methods of solving these problems may be just as effective. It is thought that reasonable accurate measurement may be obtained if common sense and good judgment are used, and the principles of good gas measurement are kept in mind. ■

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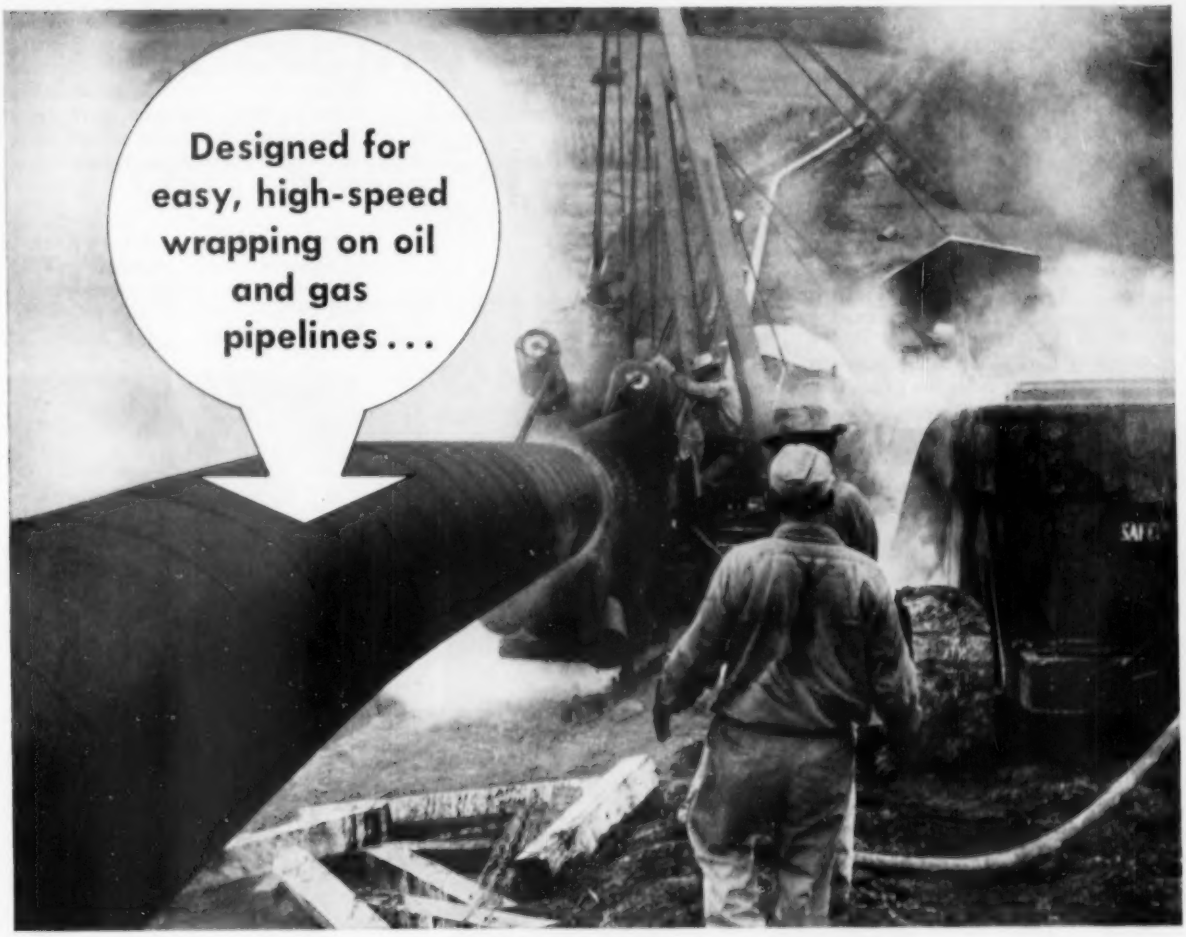

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GAS pipeline people

EDWIN A. BOOTH has been appointed manager of the Tubular Products division of Jones & Laughlin Steel Corp., Pittsburgh, succeeding C. T. HAPGOOD.

FRANK L. MERWIN has been named assistant general traffic manager for Kaiser Steel Corp., Oakland. He has been manager of the rate department.

GORDON LEFEBVRE, formerly president of the Cooper-Bessemer Corp., has joined the staff of the Clark Bros. Co., Olean, N. Y. He will serve in a consultant capacity.

C. D. ATTAWAY, former superintendent of measurement and division safety engineer for Arkansas Louisiana Gas Co., has been named works manager of the natural gasoline extraction plant being constructed for Gulf Natural Gas Corp. near Oil City.

Several changes in the Houston office have been announced by Texas Illinois Natural Gas Pipeline Co., Chicago. E. FLOYD HUMPHRIES is assistant chief geologist; EDWIN A. ALLEN is assistant superintendent of production; ALBERT G. PETZOLD, formerly administrative assistant to the vice president of operations, succeeds Mr. Allen as office manager in Houston. Texas Illinois has also appointed JOHN W. KIRSTEIN field superintendent of pipelines.

O. E. THOMPSON has been promoted to assistant sales manager by T. D. Williamson Inc., Tulsa. Assisting him will be KENNETH HULSE and JOHN MONTGOMERY.

O. E. Thompson
T. D. Williamson

P. R. Becker
Midwest Piping

PHIL R. BECKER is general manager of sales for Midwest Piping Co. Inc., St. Louis. He has been sales manager of the company's welding fittings division.

Five new sales office appointments are announced by Foxboro Co. E. W. PRENDERGAST, formerly branch manager at Atlanta, is regional manager of the southeast territory. R. F. SUTTON has transferred from Pittsburgh to Pensacola, Fla., as industrial engineer. F. J. STEVENS JR. is industrial engineer at Lakeland, Fla.; H. C. CRAIG is Jacksonville, Fla., branch manager, and L. C. ESTES is Atlanta branch manager. Other new managers are G. W. REED JR., New Orleans and J. K. YOUNKINS, Charleston, W. Va.

JOHN WILLIAMS has been elected president of the newly formed Williams Brothers Corp., which has been organized to handle the engineering work of various Williams enterprises. C. M. COLLINS, formerly chief engineer of Williams Brothers, is executive vice president; VINCENT BUTLER is vice president, and WILSON N. GILLIAT, chief engineer.

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RICHFIELD OIL CORPORATION
SOUTHERN COUNTIES GAS CO.
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SOUTHERN CALIFORNIA GAS COMPANY

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THE TEXAS PIPE LINE COMPANY
PIONEER NATURAL GAS COMPANY
TRUNKLINE GAS COMPANY
TRANSCONTINENTAL GAS PIPE LINE CORP.
TEXAS EASTERN TRANSMISSION CORP.
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GAS progress reports

NEW CONSTRUCTION PLANNED

IROQUOIS GAS CORP., Buffalo, N. Y. Docket G-9667 for 14 miles delivery pipe; 22 miles gathering and well lines; 16 new wells and 64 reclaimed and reconditioned wells; 900-hp compressor station to develop underground storage area in Chautauqua, Cattaraugus, and Erie counties, N. Y.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston. Docket G-9588 for 12.3-mile line and two meter stations to take 38 MMcf/day from Live Oak gas field in Vermilion parish, La.

CURRENT CONSTRUCTION

AMERICAN LOUISIANA PIPE LINE CO., Detroit. Docket G-2306 to construct 1289 miles of line—30-in. from North Tepetate, Acadia parish, La., to connect with Michigan Consolidated facilities near Detroit; 24-in. to feed into 30-in. line in Louisiana, also three 10,000-hp compressor stations. Included but not approved is the 117-mile, 22-in. line to extend from Payne, Ohio, to Bridgman, Mich., to connect with Michigan Wisconsin Pipe Line Co. Brown & Root has laid 73 miles, Houston Contracting 142 miles, H. C. Price 156 miles. All major river crossings are complete. Completion is scheduled for June 1956 and project is on schedule.

ARKANSAS LOUISIANA GAS CO., Shreveport. Docket G-2307 for 134 miles of 6⅝- to 24-in. line in 11 sections, and 10,500-hp compressor station on its system in Arkansas, Louisiana, and Texas. Compressor station and 71 miles of line completed.

COLORADO INTERSTATE GAS CO., Colorado Springs. Docket G-2121 - (1956 program) 239 miles of 22-in. line from Laramie, Wyo. to connection with proposed Pacific Northwest Pipeline Corp. line at Green River, Wyo.; with 4400-hp compressor station near Green River. R. H. Fulton will start two spreads April 15. Completed by Nov. 1.

PACIFIC NORTHWEST PIPELINE CORP., Houston. Dockets G-1429 and 8932 et al for 1487 miles mainline; 443 miles of spur and lateral lines; and 13 mainline compressor stations totaling 83,500 hp and 2 booster stations totaling 4620 hp, to extend from Ignacio, Colo., in the San Juan basin, to Sumas, Wash. (Canadian border). Fish Northwest Constructors Inc., builders of the line, have let contracts to River Construction Corp., R. H. Fulton & Co., Associated Pipeline Contractors, A. J. Curtis Construction Co., B. & M. Construction Co., Midwestern Constructors Inc., H. B. Zachry Co., and Fulghum Construction Co. for first 1061 miles. Completion scheduled for fall of '56. As of Jan. 1, about 691 miles of mainline and 163 miles of gathering and lateral lines had been lowered in.

TENNESSEE GAS TRANSMISSION CO., Houston. Dockets G-2310, G-2330 and G-2331. Construction is underway at Morehead, Ky. on new compressor stations. Balance of project completed.

TEXAS EASTERN TRANSMISSION CORP., Shreveport. Docket G-2503. Three compressor stations remain to be completed.

TRUNKLINE GAS CO., Houston. Dockets G-8664 and G-8665 for eight new compressor stations in Texas, Louisiana, Mississippi, Tennessee, and Illinois totaling 56,000 hp; and 24 miles of line paralleling existing system in Texas. Line completed; stations nearing completion.

UNITED GAS PIPE LINE CO., Shreveport. Docket G-8230 for 62 miles of line in Mississippi, Alabama, and Florida; 21-mile, 20-in. loop serving Pensacola 98% completed by Western Pipe Line Inc.; 7.3-mile line 65% completed by Berry Construction Co. Additions to compressor stations 80% completed by Joe R. Turner.

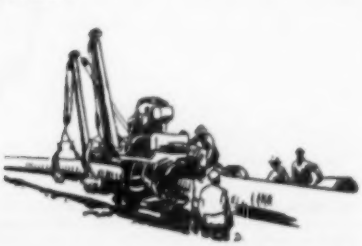
WESTCOAST TRANSMISSION CO. LTD., Calgary. To build 650-mile, 30-in. line from Peace river area to near Vancouver, B. C., to connect with line of Pacific Northwest Pipeline Corp., to transport 370 MMcf daily, of which 300 MMcf is to be delivered to PNW. Work has commenced on all four sections between Peace river and International Border.

CONTRACTS LET

TEXAS GAS TRANSMISSION CORP., Owensboro, Ky. Docket G-8828 for 189 miles of line and 20,270 hp in compressor capacity along its system in Louisiana, Arkansas, Mississippi, Tennessee, Kentucky, and Indiana. Contracts for 10,820 compressor hp let to Longview Equipment Co. and 6000 hp to Ford, Bacon & Davis.

APPROVED

NATURAL GAS PIPELINE CO. OF AMERICA, Chicago. Docket G-4280 for 260-mile 26-in. line from Fritch, Texas, through southwestern Oklahoma to a point in Grady county, Okla. From there a 90-mile, 20-in. line to Wise county, Texas; total distance: 350 miles, to transport additional quantities of gas to existing mainline facilities.



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WHAT'S NEW AT BRISTOL...

RIDING 250-MILE PIPELINE from his desk at Charlotte, N. C., Piedmont's gas dispatcher makes instant decisions with aid of this battery of 1- and 2-pen Bristol recorders. They show pressure, temperature and flow at 46 remote points.

Takes 46 readings over 250-mile pipeline with only 4 wire circuits

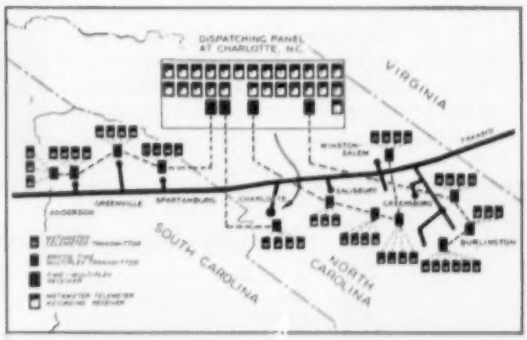
Piedmont Natural Gas Company is first to use new Bristol Intermediate Time-Multiplexing system

With the new Intermediate Time-Multiplexing system, only four leased wire circuits are needed to send readings from 46 telemeter transmitters along Piedmont's 250-mile pipeline to a central dispatching headquarters at Charlotte, N. C.

The close continuous supervision provided by the new Bristol instrumentation system enables operation of Piedmont's complex gas distribution facilities at nearly 99% load factor.

Multiplexed Bristol Metameter Telemeters provide transmission of up to 15 instrument readings over a single wire circuit. With the new Intermediate Time-Multiplexing, these readings may be multiplexed onto the line at *widely separated intermediate stations*—effecting great economies in the number of required circuits.

Find out how these Bristol Metameter Telemeters can solve *your* complex telemetering problem in the most economical manner. Write The Bristol Company, 119 Bristol Road, Waterbury, Conn. 5.45



TWO-STATE COVERAGE with only four leased telephone circuits is effected by this instrumentation system. Note that as many as four intermediate time-multiplex transmitters add readings to a single circuit at different points.

BRISTOL

BRISTOL'S

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

GAS pipeline news

Court dismisses injunction against FPC Order 174-B

Temporary injunction and complaint of Union Producing Co. against enforcement of FPC Order 174-B have been reversed and remanded by the United States court of appeals for the District of Columbia.

Union sought to enjoin enforcement of the order, and the District court granted a temporary injunction, which the FPC appealed. The circuit court ruled that Union cannot maintain the suit because the administrative remedies have not been exhausted. The court pointed out that the statutory scheme on judicial review contemplates an initial decision by the FPC and that a petition for a declaratory order status determination was available to Union.

Little Big Inch conversion plan goes back to FPC

Texas Eastern Transmission Corp.'s certificate to reconvert the Little Big Inch to petroleum products has been remanded to the FPC for further proceedings by the U. S. court of appeals for the District of Columbia.

"Texas Eastern will continue to pursue actively its plans to convert the Little Big Inch," George T. Naff, president of the Shreveport company, stated. "It is hoped that the additional hearings required by the court's actions will not delay greatly the date on which the reconversion can be accomplished.

"The company is confident that its authority to reconvert will ultimately be upheld. Meanwhile, we are continuing to prosecute actively our application to the FPC for authority to expand our . . . system and build a new line to the Mexican border. The court decision will have no effect on that expansion."

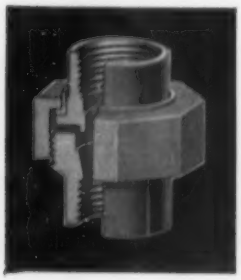
Wright-designed Price Tower dedicated in Bartlesville

A significant development in the field of modern architecture took place last month when the new 19-story Frank Lloyd Wright-design Price Tower of Bartlesville, Okla., was dedicated and opened for a three-day inspection by the public.

The narrow Price Tower design makes every unit of space an outside unit. Expansive window areas provide a great deal of natural light and a constant view of the outdoors. Roof gardens on the covered carports and the Tower itself are a part of this scheme.

The new building, owned by the H. C. Price Co., pipeline constructors, was 3½ years in the planning and construction stages. It is a narrow (approximately 45-ft width wall faces) tower structure. A two-story wing is occupied by the Bartlesville offices of Public Service Co., while offices of the Price company are located on the 12th through 19th floors of the building. Other portions of the building are available for office rental, and there are eight apartments in the Tower.

The tower itself is cantilever style construction with floors and walls sus-



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Insulated Union

Gives cathodic protection at meters—Galvanic corrosion in service piping can be effectively reduced by cathodic protection at meter connections. This rugged, malleable iron Crane union breaks the current path by means of special insulation.

Between union ring and tail-piece there's an L-shaped washer of laminated phenolic thermosetting plastic. Between tail-piece and thread-piece a thick black rubber gasket breaks the metal-to-metal contact. Both insulating parts have high dielectric strength.

New union measures just slightly longer than the regular ¾-inch Crane malleable union—approximately 2-7/32 inches, end to end. Packaged in cartons of 30.

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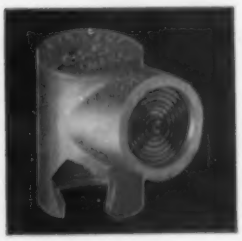

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A flexible stainless steel coil spring takes the place of the old bar grille or rigid screen in this new Crane vent elbow. Keeps out bugs, insects, foreign matter. Flexes outward if regulator is vented. Durable, dependable—die cast of zinc alloy.

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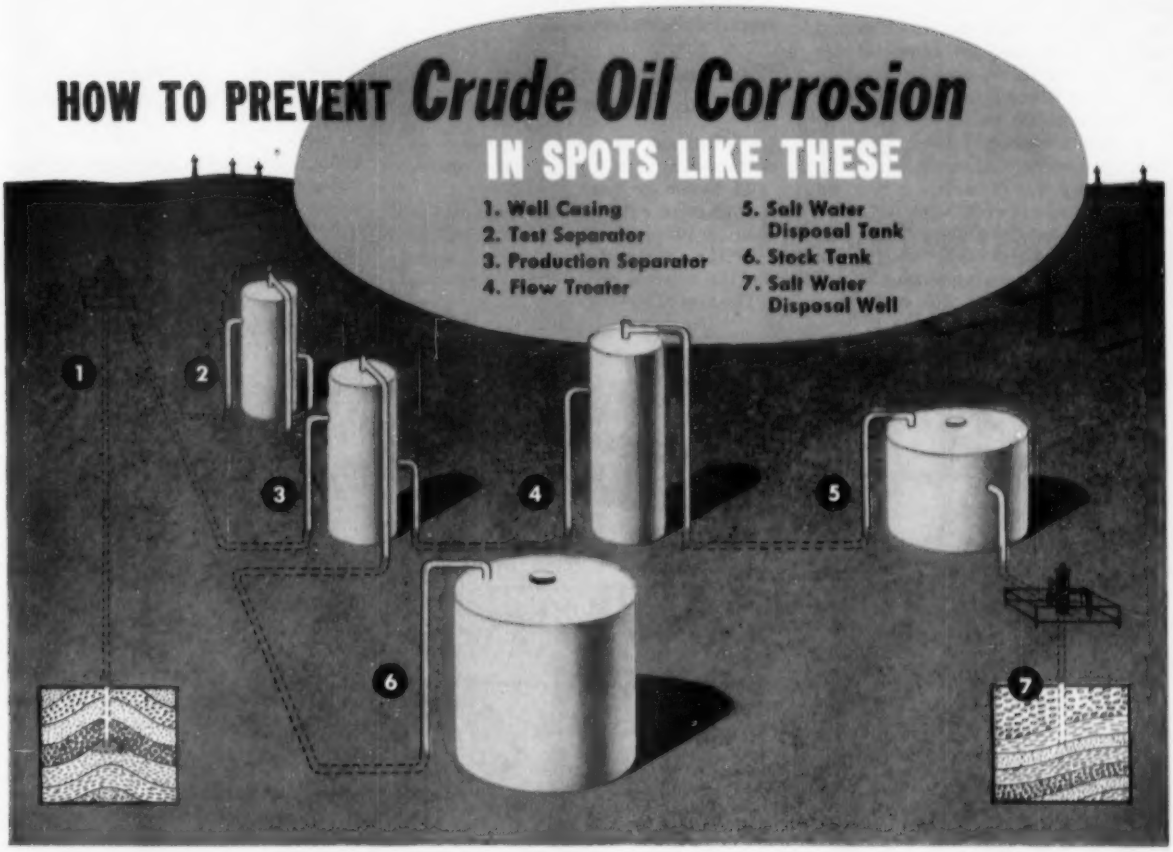

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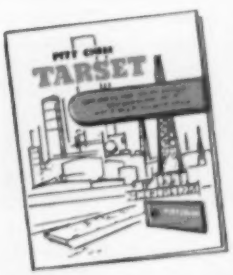

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pended from four vertical steel-reinforced concrete supports, which extend outward from near the center of the structure and act as interior dividing walls. Each tower floor is thus divided into four separate quadrants.

A unique feature of the building is that one quadrant of space extending vertically up the Price Tower is to be devoted to apartments, with the other three quadrants providing office space. It is believed that, while many office buildings have been remodeled to include apartment space, this is the first time the original design included such dual planning. Separate entrances and elevators serve the office and apartment areas of the building.

Pipeline projects okay for United, Southern Natural

Certificates have been granted to United Gas Pipe Line Co., Shreveport, and Southern Natural Gas Co., Birmingham, for the construction and operation of pipeline facilities designed to make additional natural gas available on the systems of the two companies (Dockets G-8230, et al).

The decision authorizes approximately 63 miles of pipeline and a new 330-hp compressor station on United's system in Mississippi, Alabama, and Florida. Estimated cost of the project is $10,055,832. Southern's project includes a total of about 52 miles of pipeline and 4950 additional hp in compressor capacity on its system in Alabama, Georgia, Louisiana, and Mississippi. Cost is estimated at $2,361,219. Both companies have already received temporary authority from the FPC for various phases of their projects.

United's certificate covers the development and operation of its Jackson, Miss., storage project; facilities for the delivery of gas to the Escambia Bay Chemical Corp. at its Santa Rosa County, Fla., plant; and other new facilities in its Jackson, Miss., district to increase the peak deliverability of its system there, and to provide for the sale of an additional 51 MMcf of natural gas per day to Southern through an existing interconnection at Kosciusko, Miss.

Southern's new facilities are designed to increase its system capacity from the presently authorized 936 MMcf of natural gas per day to a new total of 989 MMcf.

Contract demand rate form okayed for Columbia firms

Uniform rate schedules for two Columbia Gas System subsidiaries (United Fuel Gas Co. and Central Kentucky Natural Gas Co.) have been approved by an FPC presiding examiner (Dockets G-2450, et al). He holds that the schedules are necessary to meet the financial and operating necessities of the companies.

The companies are seeking wholesale natural gas rate increases amounting to $15,690,000 annually for United Fuel and $3,452,000 for Central Kentucky. Central Kentucky purchases substantially all of its gas from United Fuel.

Both companies have been unsuccessful in previous efforts to obtain FPC approval of the contract demand (CD) form of rate approved. Central Kentucky, in the present proceeding, proposed the CD rate form for all its jurisdictional sales, while United Fuel proposed two rate forms—the CD for central Kentucky, Atlantic Seaboard Corp. (another Columbia subsidiary, of Charleston), and the Portsmouth (Ohio) Gas Co., and the limited service (LS) form for its two other jurisdictional customers, Ohio Fuel Gas Co., Columbus, and Manufacturers Light & Heat Co., Pittsburgh, also Columbia subsidiaries.

Presiding Examiner Hall, pointing out that the different rate form would produce, without justification, higher

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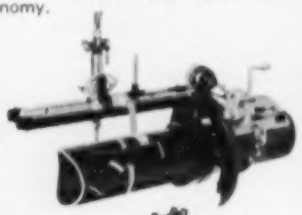

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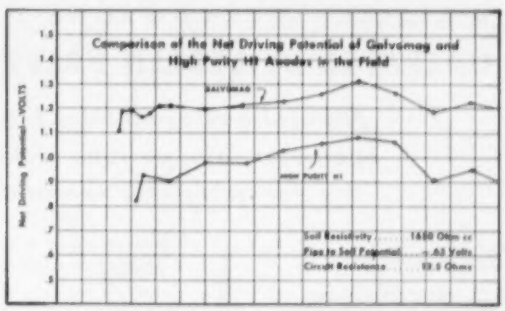
Results: Galvomag Best

Dow's new high-potential anodes furnish 25% more current output than conventional anodes . . . save you money by requiring fewer installations!

Because of their higher driving potential, four GALVOMAG* anodes do the work of five conventional anodes in average soils—a distinct savings for you in installation costs.


Comparison of the Net Driving Potential of Galvomag and High Purity Mg Anodes in the Field
Net Driving Potential—VOLTS
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Soil Resistivity ..... 1650 Ohm cm
Pipe to Soil Potential ..... -.85 Volts
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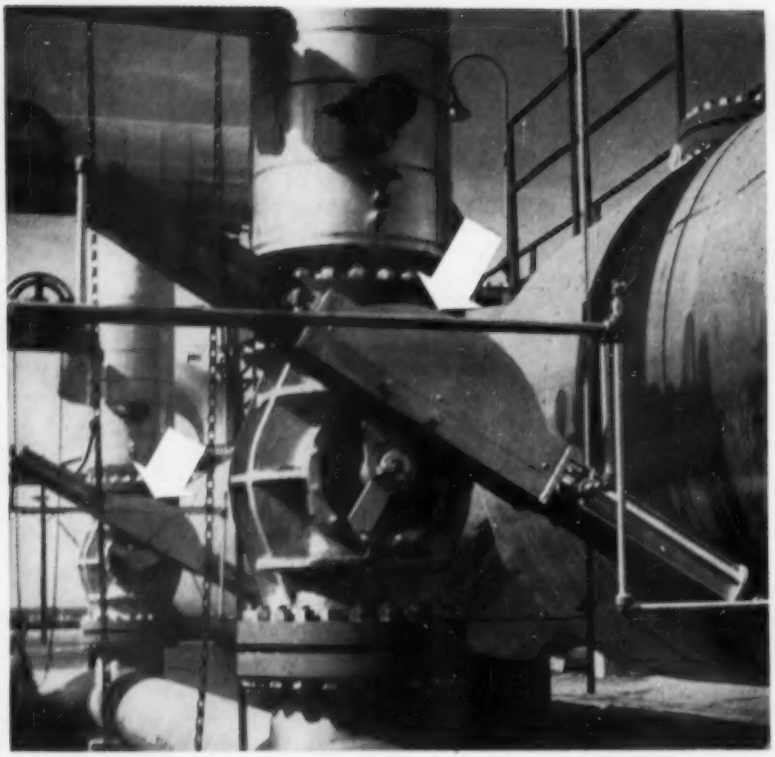

(Unretouched photo of Ledeen Valve Actuators in operation)

AMINE RECOVERY PLANT PLUG VALVES OPERATED BY LEDEEN VALVE ACTUATORS

Natural gas companies find these operators safe, positive, dependable for automatic operations

LEDEEN TIME DELAY VALVE

When lightning strikes or power fails, this new valve keeps station on line. If power is not restored within adjustable time delay limit set by the valve (2 seconds to 2 minutes), station is blown down and lines vented. Write for data on this compressor station watchdog.

Ledeen Valve Actuators are used in compressor stations on automatic blowdown valves, fuel shutoff valves, relief valves, pipeline and station block valves, and many more applications along with the Amine Recovery Plant installation shown.

These valve actuators are pneumatically and hydraulically operated, do not leak and are easily mounted by field personnel without modification of plug valve. They can be mounted in any position around the valve; and are available with auxiliary manual operation, either at valve or at a remote location. For preventive maintenance, actuator and control system can be operated without turning the valve. Torque ranges from 500 to 500,000 inch pounds.

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billing demands for deliveries to Central Kentucky, Seaboard and Portsmouth than to the other two customers, ruled that United Fuel should have uniform rates without a differential favoring Ohio Fuel and Manufacturers.

Discussing the question of which of the two-part rate forms should be approved for United Fuel and Central Kentucky, the presiding examiner stressed that the CD form has as its objective a year-to-year financial stability to assist the companies in meeting their operating necessities and in developing in a financially sound aand orderly manner. The principal difference between the LS and CD rate form lies in the determination of the billing demand. The demand charge under the LS form is based on actual use during the current and preceding 11 months, while under the CD form the billing demand is a least 90% of a predetermined amount of available capacity as requested by the customer. (Under a two-part rate the total cost of service is recovered through the demand and commodity components. Through the commodity charge the customer pays a fixed amount per unit of gas delivered. The demand charge provides for payment to compensate the supplier for reservation and use of capacity.)

Presiding Examiner Hall said that the CD rate form provides that the purchaser will enter into a long-term agreement and predict its maximum single day's requirements. Thus, he said, the CD form gears the billing demand to an estimate and causes jurisdictional customers to pay minimum costs each year regardless of peak day fluctuations in requirements. Under the LS form, the wholesale customers would pay on an actual take basis regardless of their estimated maximum single day's requirements.

In approving the CD rate form, the examiner said that it "assures United Fuel and Central Kentucky a measure of protection (payment of part of the suppliers' rate on the basis of the customers' estimates) in the event that their customers' estimates are not realized." The end result of this, he indicated, would be that the revenues from jurisdictional sales of United Fuel and Central Kentucky will be stabilized to an adequate extend during changing conditions, whatever the cause.

The presiding examiner declared that "it being a certainty that the full capacity provided by the suppliers will not be used more than once every five or ten years, and the suppliers' fixed costs are incurred and must be recovered, as well as passed on to the ultimate consumer, each year, the suppliers seek to stabilize their revenues on a year-to-year basis, to the extent of the

CD minimum bill, rather than have their revenues recovered on a 'feast or famine' basis (less than the cost of service in warm years and more than the cost of service in cold years) inherent in the billing determinant under the LS type of rate—without a minimum bill."

In concluding, he declared that "now that billions have been invested in the natural gas industry the commission is faced with the necessity of giving equal attention, if not greater attention, to the protection of the investments made. Perhaps the greatest need of the industry today and in the future is stability to the end that it may still march on for the benefit of all, and it is the necessity for stability in the case at bar which compels the examiner to look favorably upon the requests for CD rate forms for United Fuel and Central Kentucky."

E. C. Robinet

R. R. Hughes

T. D. Williamson Reps

T. D. Williamson expands far-western coverage

R. M. Riddell

Extending its area of domestic representation, T. D. Williamson Inc., Tulsa, has appointed R. R. Hughes of R. R. Hughes Co., Seattle, as representative for the Pacific Northwest, including Washington, Oregon, Idaho, and Montana.

Williamson has also expanded its California representation by appointing E. C. Robinet of Cameron Engineering Co., Los Altos, and R. M. Riddell of R. M. Riddell Co., Pasadena, as northern and southern California representatives, respectively.

Washington contracts let for Pacific Northwest line

Construction contracts covering 420 miles of mainline and 340 miles of laterals for the Pacific Northwest Pipeline Corp. system in the state of Washington were awarded last month, according to R. D. Ricketts, president of Fish Northwest Constructors Inc., designers

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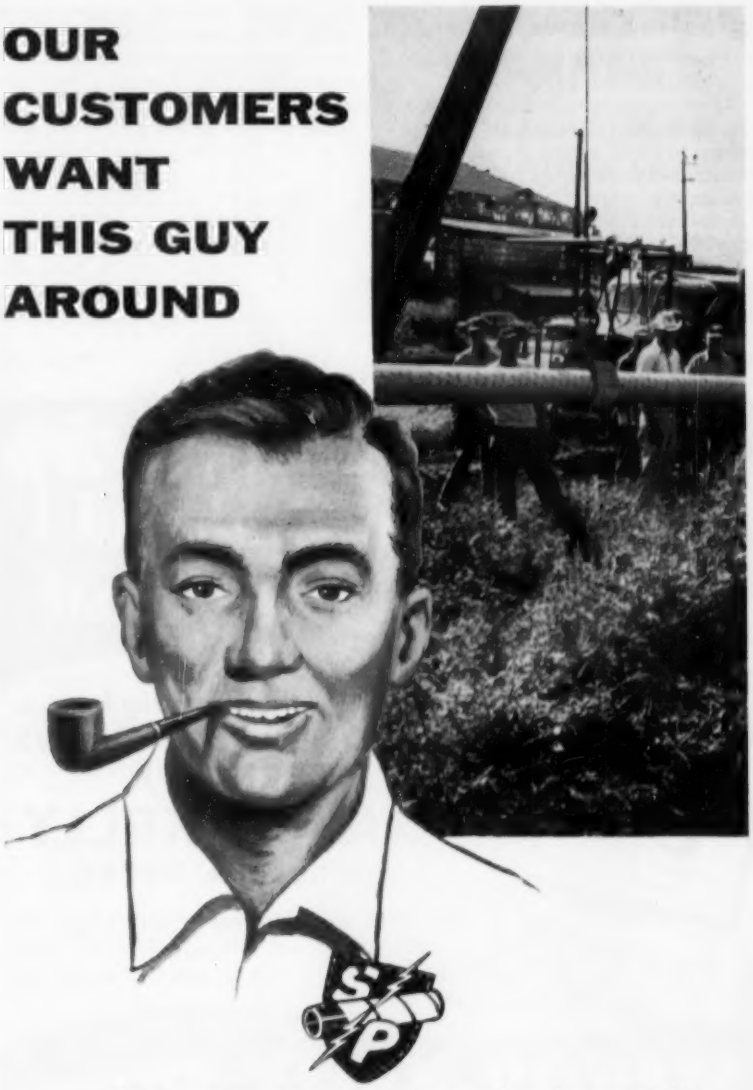

For over a year now, our service men have been available to assist your inspectors in your construction work. Our customers have increasingly expressed their appreciation of this assistance, which is available to you for the asking.

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pipeline news • *Cont'd.*

and builders of the line. Fish Northwest are agents for PNW.

These contracts cover the major portion of construction scheduled for completion in 1956. Several contractors are already in the field, and all schedules will be underway in the near future. Fifteen contractors will be working on schedules in Washington this spring.

Mainline contracts call for 26-in. pipe, with laterals of 20-, 16-, 12-, 8-, 6-, and 4-in. pipe. Mainline system awarded begins at a point near Plymouth, Wash., to Sumas, near the Canadian border. Laterals include lines to Walla Walla, Spokane, Wenatchee, and the Columbia river crossing and lateral to Portland, Ore. Contracts were also awarded for 129 miles of laterals for Idaho markets in Coeur D'Alene, Moscow, and Lewiston.

Contractors are as follows:

Schedule 13: 81 miles, 26-in., between Plymouth and Goldendale, Wash.—A. P. V. Co. Inc., Fort Worth.

Schedules 14 and 15: 56 miles, 26-in. between Goldendale and Stevenson, Wash.—Engineers Ltd Inc., San Francisco.

Schedules 16 and 17: 79 miles, 26-in. between Stevenson and Toledo, Wash.—Midwestern Constructors Inc., Tulsa.

Schedule 18: 64 miles, 26-in. between Toledo and Tacoma.—River Construction Corp., Fort Worth.

Schedule 19: 53 miles, 26-in. between Tacoma and Duvall, Wash.—B&M Construction Co., Oklahoma City.

Schedules 20 and 21: 87 miles, 26-in. between Duvall and Sumas—Curtis Construction Co., Cape Girardeau, Mo.

Walla Walla lateral: 31 miles, 6-in. from mainline to Walla Walla, Hood Construction Co., Lynwood, Calif. Spokane lateral: 156 miles, 20- and 16-in. to Spokane and 129 miles of laterals for Idaho, R. H. Fulton & Co., Lubbock, Texas. Yakima-Wenatchee lateral, 137 miles, 10-, 8-, and 6-in., Eastern Pipeline Construction Co., Fort Worth. Portland lateral and Columbia river crossing, 16 miles, 18-in. to Portland, River Construction Co., Fort Worth.

Testing underway on American Louisiana line

A 400-mile section of American Louisiana Pipe Line Co.'s 30-in. line extending from Willow Run, Mich., to Cameron, La., is being tested with compressed air and natural gas.

Three diesel engines in the process of testing the first 400 miles of the American Louisiana line from Michigan to Kentucky. A complete testing package consists of two low-stage compressors and one high-stage. Two members of the American Louisiana testing crew can be seen examining the high-stage compressor.

Ten Caterpillar diesel engines driving Gardner-Denver compressors comprise all the testing units. All of these will compress air except one, which will serve as a gas unit and will test the southern end of the line.

Each testing package is composed of one high-stage and two low-stage compressor units connected in series. The high-stage is mounted on one Martin trailer, while the two low-stage units are mounted on another.

Each trailer has a 560-gal. fuel tank for its respective engine. The two engines for the low-stage compressors draw their fuel from the same tank.

Pacific Northwest . . . Eastern Seaboard Gulf Coast

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It will supply the low-stage engines for about 24 hours and the high-stage for about 48 hours.

Initial tests along the line began near Ypsilanti, Mich. Hydrostatic tests were conducted in this highly populated area. Other tests were conducted near Slaughters with the gas unit.

It is anticipated that the first section of the line will be completed early this year and ready to deliver 50 MMcf/day to the Detroit area. The remaining mileage of the project will be completed early this summer and will deliver 300 MMcf/day with the potential of 550 MMcf when additional compressor stations are added.

Commission investigates rates of 16 producers

Investigation into the rates charged by 16 independent producers is being made by the FPC to determine whether any of the rates are "unjust, unreasonable, unduly discriminatory or preferential." All producers involved sell gas to Tennessee Gas Transmission Co., among other purchasers.

Changes in rates filed by the producers and allowed to go into effect late in 1954 resulted in a total annual increase of about $6.2 million to TGT.

Last August, the Tennessee PSC and several Tennessee cities and distributing companies, which receive gas from TGT's system, filed complaints with the FPC requesting investigations of the producers rates.

Commissioner Seaborn L. Digby, who concurred in part and dissented in part with the FPC's orders instituting the investigations, said he supported the orders insofar as they provide for investigations concerning rates specified in the complaints by the PSC and others. However, he declared that he strongly disagreed with those parts of the orders providing for investigations of all the rates being charged by the producers and not covered by the complaints. "The enlargement of the proceeding to include all rates charged by the respondent producers is unfair to the parties in the compliant proceeding, and is completely baseless in factual justification," he asserted.

Natural gets FPC okay; Lone Star's plan denied

Natural Gas Pipeline Co. of America, Chicago, has been authorized to construct a 350-mile pipeline to transport into its system natural gas which would be purchased in Jack, Wise and Parker counties, Texas, for ultimate delivery to markets in the Chicago area (Dockets G-4280, et al).

At the same time FPC denied a competing application by Lone Star Gas Co., Dallas, proposing to build a 230-

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mile pipeline in Oklahoma and Texas to make gas available to Natural.

The presiding examiner also granted certificates to three independent producers authorizing them to sell gas to Natural. He conditioned these certificates, however, by requiring the producers to file rate schedules providing for a "base price" of 11 cents per Mcf in lieu of the 15-cent price set forth in their contracts with Natural. The producers are Mid-Continent Petroleum Corp., Warren Petroleum Corp., and Oil Drilling Inc.

Natural's proposed 350-mile pipeline would extend from Wise county, to a connection with its existing system at Fritch, Texas. The three producers would sell and deliver to Natural at the wellhead from various points in Jack, Wise and Parker counties an initial average volume of 78 MMcf of gas per day. Natural plans to obtain additional quantities of gas from points along the route of its new line, and has an ultimate objective of transporting a maximum of 240 MMcf per day through the new facilities into its systems.

Total estimated cost of Natural's proposed facilities is $28,487,000. In addition, Natural would construct gathering facilities in Jack and Wise counties and make changes in its existing production and gathering facilities in the Panhandle field. The production and gathering facilities are estimated to cost $3,583,000.

Several interveners, including Lone Star, other gas companies, and the City of Chicago, opposed Natural's application principally because of the proposed initial contract price of 15 cents per Mcf. Presiding Examiner Zwerdling, in conditioning the producers' certificates to require the 11-cent rate, pointed out that the prevailing price level in the Jack-Wise counties area is 11 cents and that certification at the proposed 15-cent level would inevitably result in a general area price increase, "with consequent economic disruption . . ."

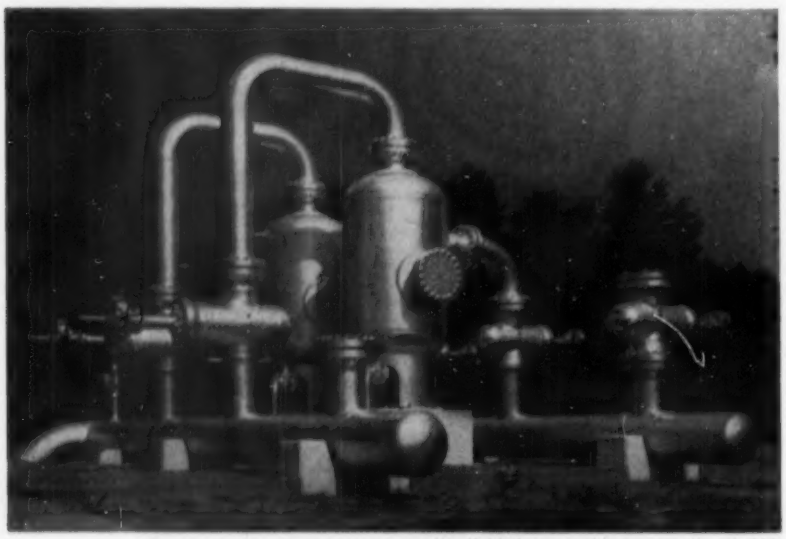
The Presiding Examiner also conditioned the producers' certificates by requiring them to file within 30 days satisfactory proof of their ability to finance their project, including a sworn statement as to the total number of gas wells completed on the dedicated acreage.

Lone Star was requesting authority to build its proposed 230-mile line to make available 100 MMcf of gas per day to Natural at Fritch, Texas. Total estimated cost of the Lone Star project is $18,749,600.

Although Lone Star had proposed to sell gas to Natural for 20.5 cents per Mcf, as compared with an initial cost to Natural under its proposal of 30.8 cents per Mcf (with the 11-cent rate condition), Presiding Examiner Zwerdling said that it was difficult to escape the conclusion that the Lone Star proposal "was not a carefully considered, firm plan, based upon a solid and fixed foundation, but rather that it was a hastily improvised device, designed primarily to block Natural from entering Lone Star's gas purchase area . . ."

He pointed out that Natural will need increasing amounts of gas in excess of 100 MMcf per day as early as 1957 and that Lone Star's proposal for its 230-mile line would fail to meet Natural's over-all gas supply problem almost from the beginning. With Natural's supply deficiency expected to reach 126 MMcf in 1959, the presiding examiner indicated, Lone Star's plans for constructing a second phase of its project to meet that demand are speculative and uncertain.

He concluded that Natural's "long-range, over-all gas supply problems would be more adequately and satisfactorily solved, and that the interests of Natural's entire system and those of its consumers would be better served" under the Natural project than under the Lone Star proposal.



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Ark La foresees $50 million pipeline to Gulf Coast

Consideration is being given by Arkansas Louisiana Gas Co. to construction of a $50 million pipeline to the Gulf Coast, according to W. R. Stephens, president of W. R. Stephens Investment Co., which gained control of Ark La in 1954 by purchasing 51% of its stock. The project will be developed "within the next few years" to bolster the company's natural gas reserves.

J. C. Hamilton, president of Arkansas Louisiana, said the pipeline is in the "probability stage" and that discussions aren't far enough along to consider financing arrangements. Although the plans are still tentative, he said the line would extend from a point near the Gulf Coast—either in Texas or Louisiana—to north Louisiana, where it would be tied into the present system.

Producers failed to show cause in termination case

The FPC has affirmed a decision by a presiding examiner holding that a group of 14 independent natural gas producers "have failed to show any cause" why they should not be required to obtain FPC permission before terminating deliveries to Texas Illinois Natural Gas Pipeline Co., Chicago.

Exceptions to the Oct. 26 decision were filed by the producers and by Transcontinental Gas Pipe Line Corp., an intervener in the proceedings. Examiner Kelly held that each of the producers is a "natural gas company" under the Natural Gas Act and subject to the jurisdiction of the FPC.

In January the FPC directed the producers to show cause why they should not be determined to be natural gas companies under the Natural Gas Act, and why they should not be required to comply with the provisions of that Act before abandoning any sales or service under contracts covering natural gas sales from the Clayton and La Gloria fields in Texas to Texas Illinois.

The contracts covering Texas Illinois' purchases in the two producing areas contain so-called "escape clauses," providing for termination at the election of the producers if the FPC imposed regulation upon them. The producers contended that the issuance by the FPC of its Order No. 174-A, on Aug. 6, 1954, prescribing regulations to govern independent producers, constituted such regulation. The producers therefore served termination notices upon Texas Illinois.

One hundred six exceptions to the examiner's decision were filed. The commission, however, declaring that the producers are engaged in substantially the same operations and sales as

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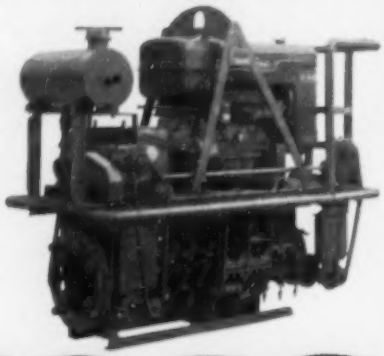

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Rehearing turned down on producer sales to Transco

Applications were denied by the FPC for rehearing of an opinion (No. 287) and order issued last Nov. 28 authorizing Transcontinental Gas Pipe Line Corp., Houston, to construct pipeline facilities to enable it to receive and transport through its system an additional 29 MMcf of natural gas per day, and granting authority to several independent producers to sell and deliver this gas to Transcontinental.

The applications for rehearing were filed by the Public Service Commission of New York and three customers of Transcontinental, who claimed that the FPC erred in failing (1) to determine the legality of the initial rate, (2) to condition the certificate by requiring the filing of an initial rate schedule stating a specific price per Mcf or a rate schedule "satisfactory to the commission," and (3) to declare the "favored nations" clauses in the contracts void and of no effect.

The commission declared that adoption of these contentions would require that prior to the issuance of any certificate the FPC would have to enter upon the equivalent of a complete rate investigation and then determine the lowest reasonable rate. The rate so determined would then be imposed by a condition attached to the certificate, the FPC said. "Such holding would not only be contrary to the plain language of the Act but would also prevent us from exercising the judgment and discretion delegated to us by Congress," the commission asserted.

The FPC said that during the hearings in the proceedings no evidence was adduced, nor was there any offer to prove, that the price to Transco was unjust or unreasonable. The commission also pointed out that there was no evidence offered to show that the rate proposed to be filed "would cause economic disruption in a considerable area."

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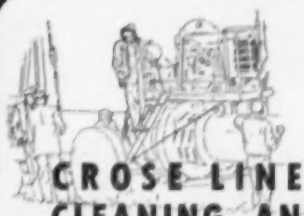

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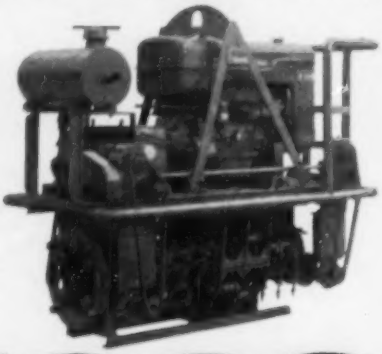

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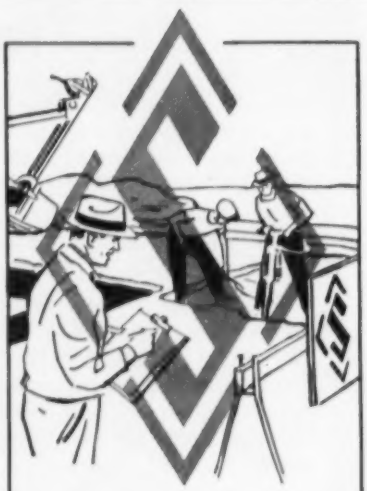

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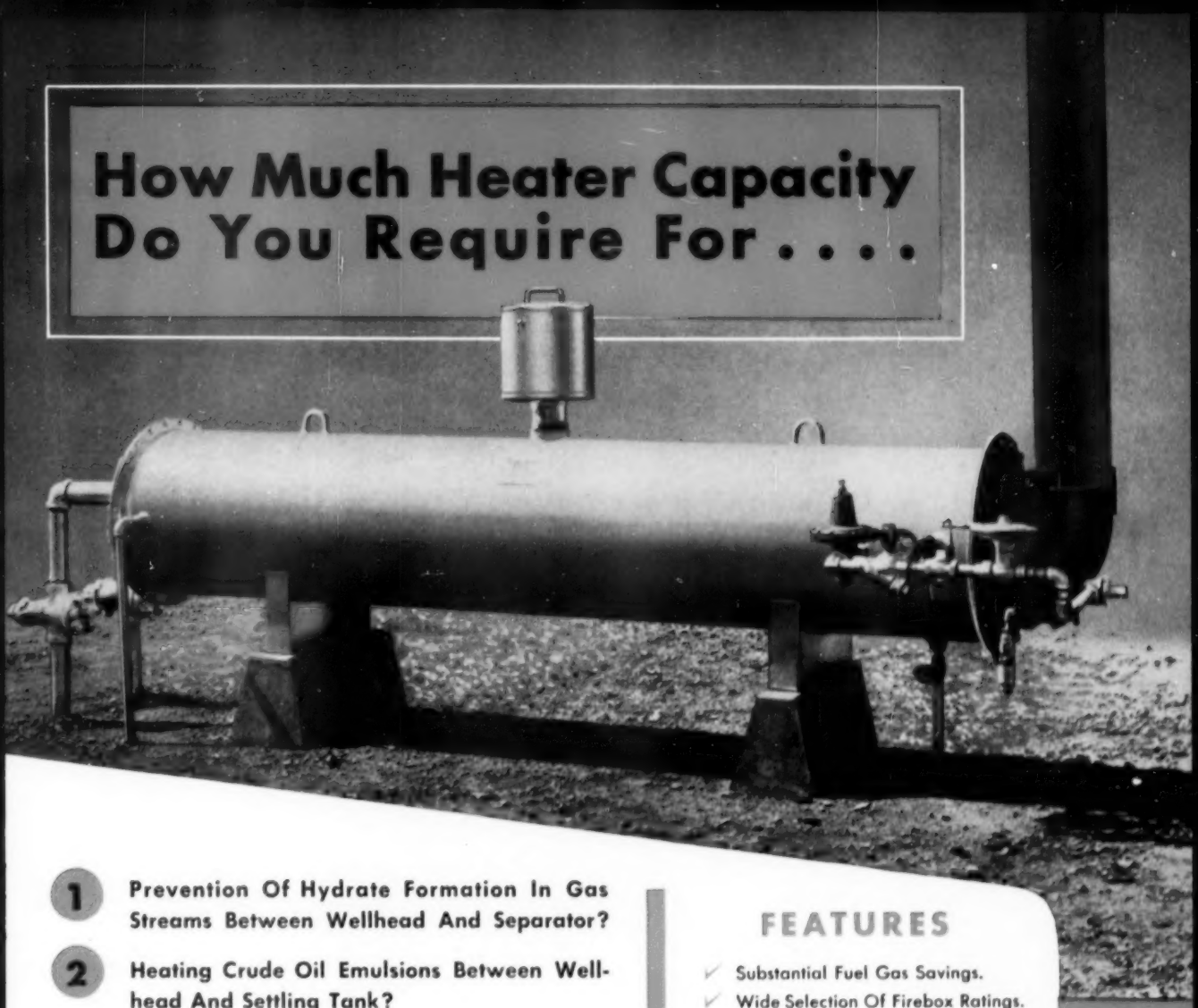
How Much Heater Capacity Do You Require For . . . .



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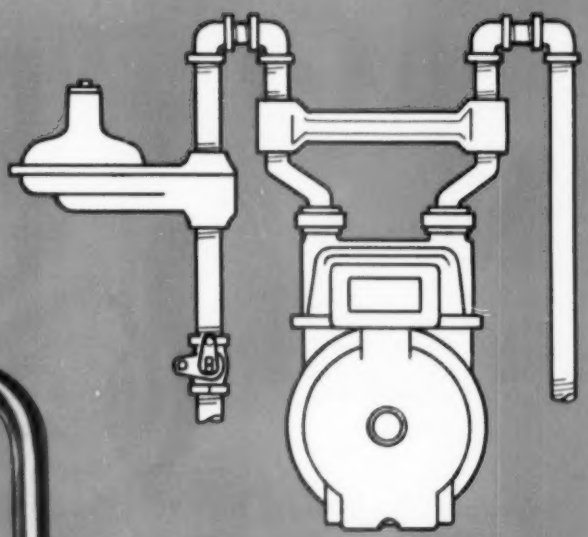

1 METER • 1 REGULATOR • 1 METER BAR
7 NIPPLES • 4 ELBOWS • 2 CONNECTION SWIVELS

A complicated, labor-wasting set-up with sixteen separate parts, sixteen pipe threads and two connections to make for each installation.

the modern Sprague way..

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